FM 1960

ACCESS MANAGEMENT STUDY

October 2004

HNTB

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Houston-Galveston Area Council (contracting entity)

in partnership with:

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North Houston Association
Texas Department of Transportation

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The preparation of this document was financed in part through grants from the U.S. Dept. of Transportation under Section 112 of the 1973 Federal Aid Highway Act and Section 8(d) of the Federal Transit Act of 1964, as amended. The content of this document does not necessarily reflect the official views or policy of the Federal Highway Administration, Federal Transit Administration, U.S. Dept. of Transportation, Texas Dept. of Transportation, Houston-Galveston Area Council, Harris County, Houston Northwest Chamber of Commerce or North Houston Association. Acceptance of this report does not in any way constitute a commitment on the part of any of the above agencies to participate in any development depicted therein nor does it indicate that the proposed development is environmentally acceptable in accordance with appropriate public laws.

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SECTION 1

INTRODUCTION

Purpose of the Study

Under contract by H-GAC, the HNTB team was charged with identifing Access Management improvement techniques for the FM 1960 corridor, from Gatewick Road on the east to Mills Road on the west, that will enhance traffic flow, improve safety and generally ameliorate the physical character and functionality of the corridor.

The plan will identify short- and medium-range improvement projects that are aimed at reducing crashes and enhancing mobility. The study also will recommend key long-term strategies to foster improved economic growth and development by identifying opportunities for better circulation between adjacent businesses and residential areas; backage and supporting street systems; grade separations from cross traffic; and opportunities for private sector aesthetic and landscape treatments, which can help to stimulate economic development within an area by creating an environment that promotes commercial activity.

Study Area

At the turn of the 20th Century, the area around modern-day FM 1960 was largely pine woods adjacent to a vast farming community. The rural population increased modestly over the years until the boom years, beginning in the mid to late 1950s, rapidly suburbanized this forested land. It was at this time that Bammel Road (a dirt road east of Stuebner Airline) and Jackrabbit Road (the road west of Stuebner Airline) were renamed FM 1960.

The discovery of oil in the Bammel area in 1938, rapid job and population growth in the Houston area, and the opening of George Bush Intercontinental Airport generated a strong demand for housing in the northwest Houston area. Collateral commercial and retail development centered along the FM 1960 corridor.

FM 1960 is the primary east-west thoroughfare through this largely unincorporated area of north Harris County. More than 64,000 cars per day travel the 9 mile stretch of FM 1960 between IH 45 and SH 249. Dense commercial, retail and residential development adjacent to this seven-lane facility continues to cause motorists delay and frustration. With a residential population of nearly 100,000 immediately adjacent to FM 1960 and more than 450,000 in the area, and taking into account the

Project Facts:

Facility Type:	Farm-to-Market Road - Principal Arterial
Study Limits:	Gatewick Road to Mills Road (approximately 9 miles)
Facility Owner:	Texas Department of Transportation
Facility Operations:	Texas Department of Transportation and city of Houston
Number of Lanes:	7 lanes
Right of Way:	100 feet

anticipated growth over the next 20 years, congestion will worsen.

Motorists face a number of sources of delay as they proceed along FM 1960. Closely spaced commercial driveways and numerous free-standing sign monuments throughout the corridor, along with several multi-family housing units and other residential development in the area, create a slow-down for through traffic in the right turn lane. Even more pronounced is the problem created by the continuous center turn lane, which significantly impacts the flow of traffic from cars cutting across three lanes of traffic to travel in the opposite direction.

FM 1960 has a functional classification of a principal arterial. It has more than 50 streets that intersect it within the project limits. Two - Kuykendahl Road and Stuebner Airline - also are principal arterials and three others are heavily utilized collector streets. Most of the cross streets fall within Harris County's jurisdiction, a few within the city of Houston's purview and some are privately owned.

With more than 1.5 million square feet of retail space, Willowbrook Mall is the largest retail complex within the project limits and the third largest in the Houston area. In addition, the area boasts more than 40 shopping centers or free-standing stores with more than 100,000 square feet of space. Two hospitals with access directly to FM 1960 fall within the study limits. On the west side of the corridor, Methodist Willowbrook Hospital lies just north of FM 1960 off of SH 249 and Houston Northwest Hospital is two blocks north of FM 1960 near IH 45. The Houston Northwest Hospital is the area's largest hospital with more than 500 beds and features a 24-hour emergency department.

The FM 1960 corridor has been coined a "major retail thoroughfare" by the Houston Northwest Chamber of Commerce. The Chamber currently is exploring, with area legislators, the creation of a management district for the FM 1960 corridor from IH 45 to SH 249. The purpose of the management district will be to help guide development and generate new economic and business opportunities along the corridor.

STUDY GOALS

The overall goal for the study was to develop a plan that addressed short-, medium- and long-term solutions for improved mobility, enhanced land use, reduced traffic delays and improved safety that will create an atmosphere for economic vitality within the project area.

- Improve mobility and reduce traffic delays along FM 1960
- Improve safety / decrease the number of crashes
- Provide for an open process in the project's development
- Offer opportunities for enhanced streetscape and land use
- Provide solutions that can be implemented in a timely manner

Study Process

A significant portion of the Access Management Study involved collecting and analyzing current, relevant data on the corridor such as traffic volumes, crash rates, and transit usage. Gathering public opinion through public meetings and stakeholders meetings was an integral part of the study process.

A steering committee comprised of the funding agencies and other affected governmental agencies along with the area group representation was formed to guide the technical and administrative aspects of the study. The final recommendations are based on the analysis done by the study team and the input gathered through the public involvement process and steering committee guidance.

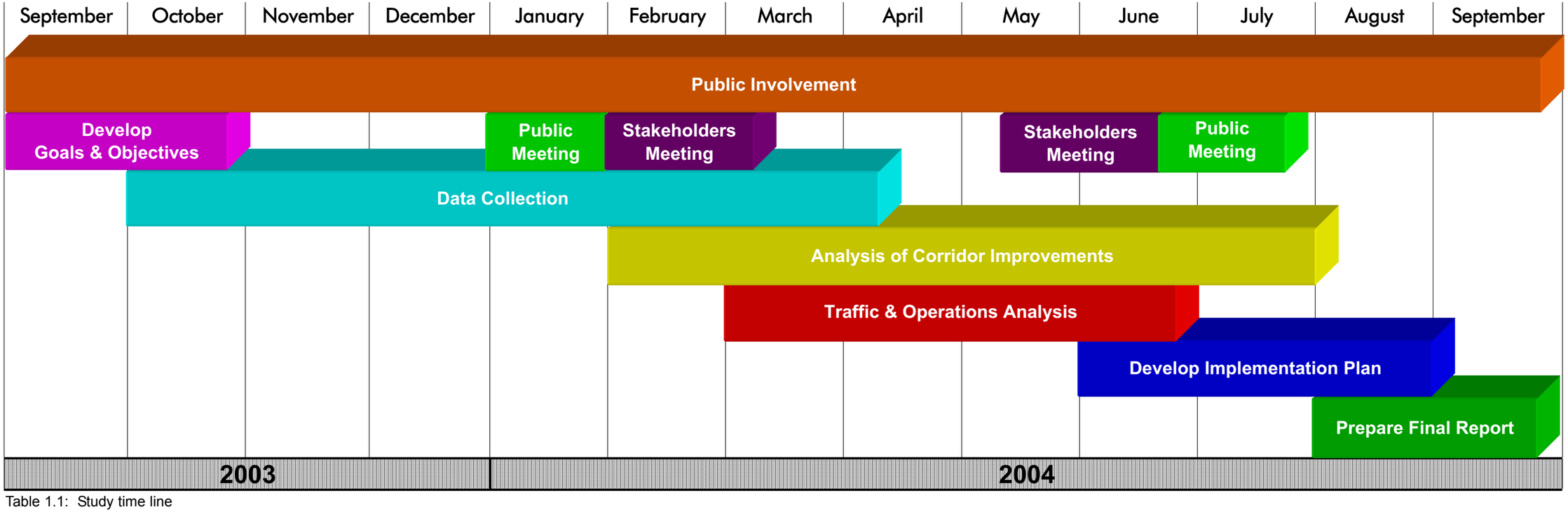
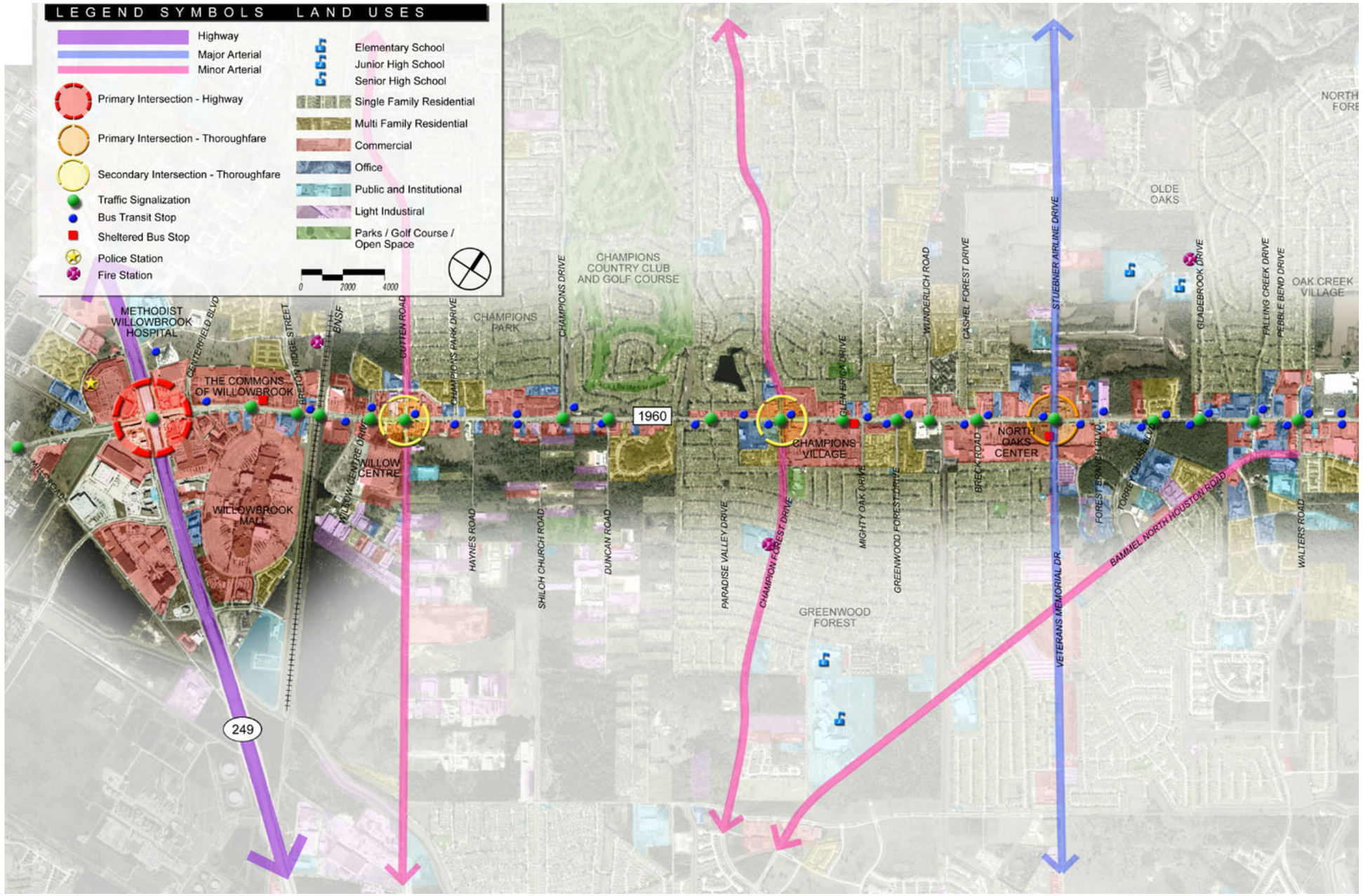


Table 1.1: Study time line

SECTION 2

ANALYSIS OF EXISTING CONDITIONS

Figure 2.1 - Corridor inventory and land use



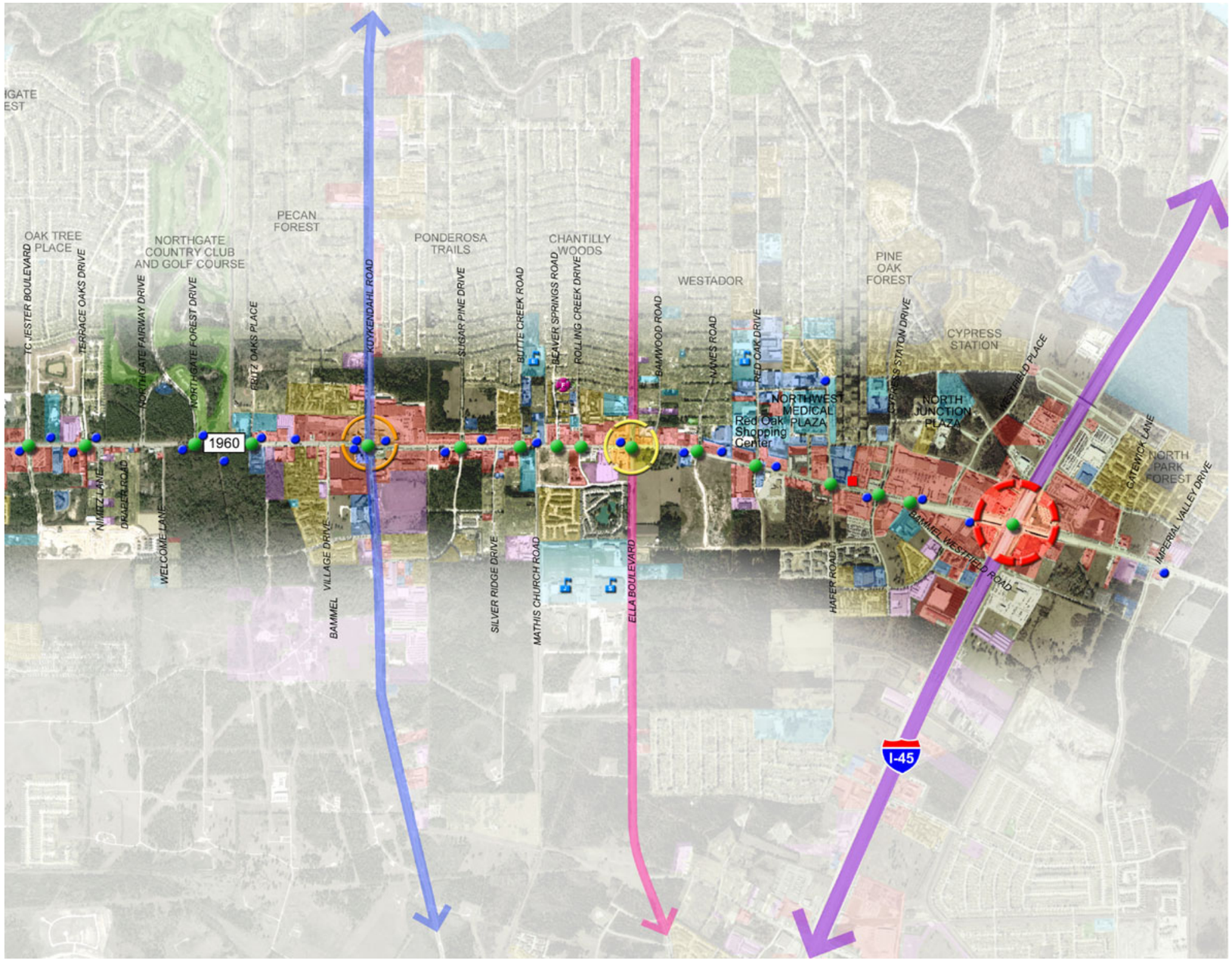


Figure 2.1 - Corridor inventory and land use, cont.

Roadway Characteristics

Within the study boundaries, FM 1960 is primarily a seven-lane concrete roadway with a curb and gutter, and 36 signalized intersections. There are two sections that currently have a raised median - SH 249 to Breton Ridge, and Cali/Hafer to IH 45. Access between intersections is facilitated by the continuous, center left-turn lane, and dedicated left-turn lanes are designated at major intersections.

The FM 1960 study section includes intersections with two major north-south freeway facilities: IH 45 and SH 249. Major intersecting thoroughfares include Cutten Road, Champion Forest Drive, Stuebner Airline/Veterans Memorial, Bammel North Houston, Kuykendahl Road, and Ella Boulevard. Parallel east-west facilities to the north of FM 1960 include Cypresswood Drive and Louetta Road. Cypress Creek is just south of Cypresswood Drive and the only three major thoroughfares that provide important connections between Cypresswood Drive and FM 1960 are Champions Forest Drive, Stuebner Airline Road and Kuykendahl Road. Ella Boulevard, with no bridge across Cypress Creek, terminates at Cy Cove to the south of Cypress Creek. North of Cypress Creek, the Ella Boulevard alignment begins just south of Blue Cypress.

The southern segment of Cutten Road terminates at Cypresswood Drive and then continues north approximately 1/2 mile west of the BNSF Railroad.

Major east-west thoroughfares south of FM 1960 are Richey Road and Spears Road, neither provides continuity between SH 249 and IH 45. The major east-west facility south of FM 1960 with a direct connection between SH 249 and IH 45 is North Beltway 8 (N. Sam Houston Parkway).

In the study area, Veterans Memorial Drive, Bammel North Houston and Kuykendahl Road are the only major thoroughfares that connect FM 1960 and N Sam Houston Parkway. T C Jester is designated as a major thoroughfare and intersects with N Sam Houston Parkway, but currently offers no north-south mobility for traffic on FM 1960. Only portions of T C Jester have been constructed and currently there is no connection between N Sam Houston Parkway and FM 1960. South of FM 1960, Cutten Road terminates at SH 249, and Champion Forest Drive terminates at Bammel North Houston. Ella Boulevard terminates south of Rush Creek Drive and does not provide direct access from FM 1960 to N Sam Houston Parkway.

Inadequate roadway connectivity in the study area contributes to congestion along FM 1960 with the increase in number and length of roadway trips.

Traffic Flow and Traffic Volumes

Traffic count data was collected along three representative segments within the project area. Twenty four hour mechanical "tube" counts, peak hour intersection traffic/pedestrian movement counts and peak period driveway traffic movement counts were recorded on weekdays (Monday -Thursday) and on weekends (Saturday) at three predetermined segments of the FM 1960 corridor.

Segment	Length/ Miles	Segment Limits	Signalized Intersections	Unsignalized Intersections
West Segment	1.5	Mills Road to Cutten Road	6	3
Center Segment	1.5	Walters Road to Kuykendahl Road	6	5
East Segment	1.5	Cypress Station Drive to Imperial Valley Drive	6	4

Table 2.1: Segments for traffic count data

Weekday Traffic Counts

In October 2003, 14 weekday 24-hour traffic counts were mechanically recorded at 15-minute intervals within the corridor. Based on this information, the peak hour was determined to be between 5 PM and 6 PM.

In October through November 2003 and March 2004, weekday peak hour intersection traffic and pedestrian movement counts were manually recorded at 15-minute intervals at all 30 signalized and unsignalized locations.

Also, weekday peak hour driveway traffic counts were manually recorded for one 15-minute interval between 5 PM and 6 PM at 60 locations in November 2003 in all three segments. In March 2004, an additional seven driveway locations were recorded in the East Segment.

Weekend Traffic Counts

In November 2003, traffic counts were recorded in the West Segment to sample weekend shopping traffic characteristics in the vicinity of Willowbrook Mall.

Weekend 24-hour counts were recorded on eastbound and westbound FM 1960 near the mall. The weekend peak hour again was determined to be from 5 PM to 6 PM.

Weekend peak hour intersection traffic/pedestrian counts were recorded on Saturdays, November 15 and 22, at four signalized and three unsignalized intersections.

Weekend peak hour driveway traffic counts were recorded for one 15-minute interval per location between 5 PM and 6 PM on November 15 and 22 at all 23 locations in the West Segment.

Traffic Flow Summary

Based on traffic counts obtained, average daily traffic volumes along FM 1960 range from 55,300 vehicles per day (vpd) between SH 249 and Cutten Road, to 64,800 vpd west of Kuykendahl between Fritz Oaks and Bammel Village. Traffic flow along FM 1960 does not show strong peak hour directional patterns. Near Willowbrook Mall, traffic flow is slightly higher in the westbound direction during both AM and PM peak hours. In the middle section near Kuykendahl, traffic flow is slightly higher in the eastbound direction during both AM and PM peak hours. In the section near IH45, traffic flow is slightly higher in the westbound direction during the AM peak hour and higher in the eastbound direction during the PM peak hour.

The traffic operational analysis focused on the PM peak

hour as the period in which higher traffic congestion and delays are observed. During the PM peak hour, west-bound traffic volumes range from 1,800 vehicles per hour (vph) near IH 45 to 2,100 vph near Kuykendahl. PM peak hour eastbound traffic volumes range from 1,900 vph near IH 45 to 2,300 vph near Kuykendahl.

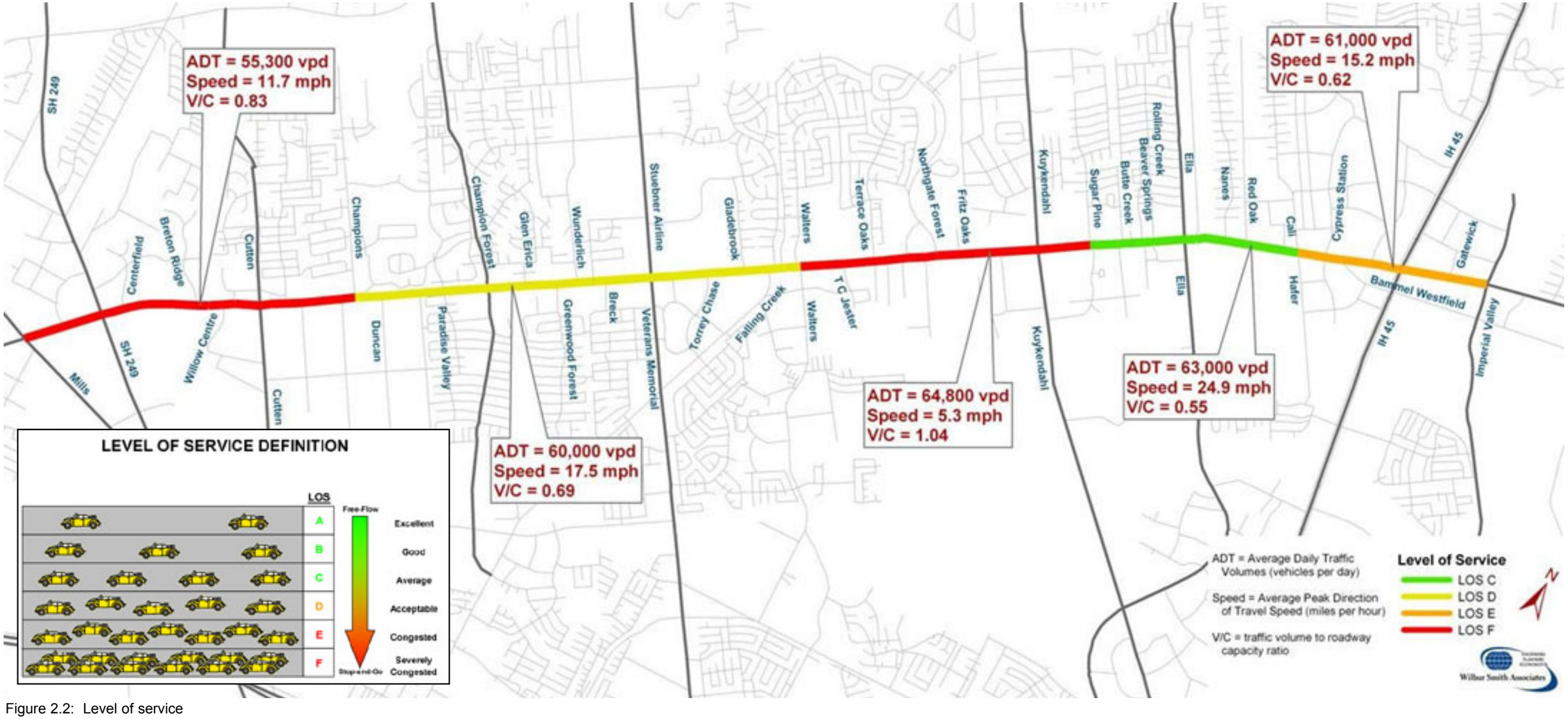
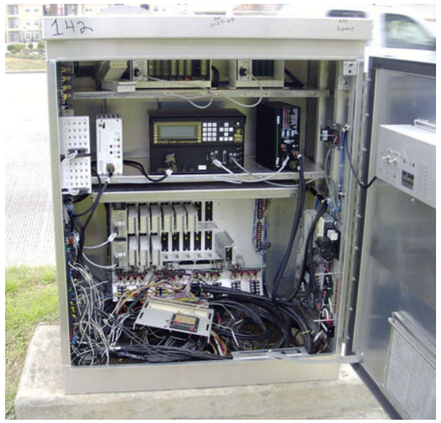


Figure 2.2: Level of service

Signal Inventory

There are 36 signalized intersections along FM 1960 between Mills Road and Imperial Valley Drive, of which TxDOT maintains all but four. The city of Houston maintains the four signalized intersections in the Willowbrook Mall vicinity. Harris County maintains the cross street signals approaching FM 1960.

A signal controller inventory was conducted in January 2004 at all 36 locations. Critical components such as the controller and cabinet type, communications cable type/connection, emergency response, vehicle detection and pedestrian detection were inventoried. Photographs of the contents of the controller cabinet, communications panel and power service were taken at each location.



Signal box at Wunderlich Road

TxDOT-maintained signals have ground-mounted "P" type cabinets and NEMA TS1 or TS2 controllers. The city of Houston-maintained signals have ground-mounted 332 cabinets and 2070 controllers. All of the controllers are fully actuated using inductive loops and VIVDS.

A 25 twisted pair (#22) communications cable interconnects the TxDOT-maintained signals. It appears TxDOT signals from Willow Centre to Cypress Station are in one subsystem, and the master controller is at Fritz Oak. Controller diagnostics on the TxDOT-maintained signals revealed communications malfunction at only a few locations (i.e., Wunderlich and Cutten).

Emergency Management System (EMS) devices that preempt normal signal operation to provide right-of-way (ROW) to a passing emergency vehicle were found at three of the four City-maintained locations. These locations include: Mills Road, Breton Ridge and the entrance to Willowbrook Mall.

TxDOT and Harris County do not install EMS preemptive devices on their signal systems, but may allow other agencies to install and maintain such devices on their signals at the installer's expense.

Currently, TxDOT uses four different cycle lengths for signal coordination and progression purposes. On weekdays the 80-second cycle runs from 10 PM to 6 AM; the 140-second cycle runs from 6 AM to 9 AM; the 120-second cycle runs from 9 AM to 3 PM; the 130-second cycle runs from 3 PM to 7 PM; and the 120-second cycle runs from 7 PM to 10 PM. At Willow Center Road and Cutten Road, the corresponding cycle lengths are 80, 105, 110 and 130 seconds respectively.

TxDOT recently retimed its signals to provide optimized progression within the corridor. Time-based coordination is used to synchronize City-maintained signals with TxDOT-maintained signals.

Crash Analysis

Crash data for the study area were obtained from the Texas Department of Transportation (TxDOT) for the three-year period from 1999 to 2001. The TxDOT Traffic Accident Records are an edited version of records from the Texas Department of Public Safety merged with TxDOT roadway information. A total of 2,171 crashes were recorded in the study area over the three-year time period, as shown in Table 2.2.

Over the three-year period from 1999 to 2001, FM 1960 corridor crash rates range from 326.4 accidents per 100 million vehicle miles traveled (accidents per 100 MVMT) in the Mills Road to Champions Drive section, to 457.9 accidents per 100 MVMT in the Hafer Road to Imperial Valley section, as shown in Table 2.3.

The statewide average accident rate for the three-year period for a Farm-to-Market roadway facility is 210.7 accidents per 100 MVMT. Typically, roadways are considered to have a significant accident problem when the accident rate is double or more the statewide average. According to this criterion, therefore, the section of FM 1960 between Hafer and Imperial Valley, with an accident rate 217% higher than the statewide average, qualifies as having a significant accident problem.

Detailed crash data for the study area were also obtained from the Houston-Galveston Area Council for the three-year period 1998 to 2000. This data provided more specific information relating to location and cause of accidents. A total of 2,316 crashes occurred in the three-year period from 1998 to 2000. Of these accidents, 42 percent were at intersections or intersection-related and 58 percent were at driveways or non-intersection related. There were a combined 123 crashes per mile for the two raised median sections (SH 249 to Breton Ridge, and Cali/Hafer to IH 45), and 148 crashes per mile for the remaining sections with a two-way center left-turn lane.

The raised median section had 17% fewer accidents than the continuous, center left turn lane section.

Sectiont	Fatality Crashes	Injury Crashes	Non-Injury Crashes	Total Crashes
Mills Road to Champions Drive	1	226	188	415
Champions Drive to Walters Road	1	345	270	616
Walters Road to Sugar Pine	1	264	156	421
Sugar Pine to Hafer Road	1	220	131	352
Hafer Road to Imperial Valley	3	221	143	367
Total	7	1,276	888	2,171

Table 2.2: Crash data from 1999 to 2001

Source: Texas Department of Transportation, Three year period from 1999 - 2001.

Section	3-Year Accident Rate (Accidents per 100 MVMT)
Mills Road to Champions Drive	326.4
Champions Drive to Walters Road	334.9
Walters Road to Sugar Pine	329.6
Sugar Pine to Hafer Road	392.5
Hafer Road to Imperial Valley	457.9
Statewide Average	210.7

Table 2.3: Three year accident rates

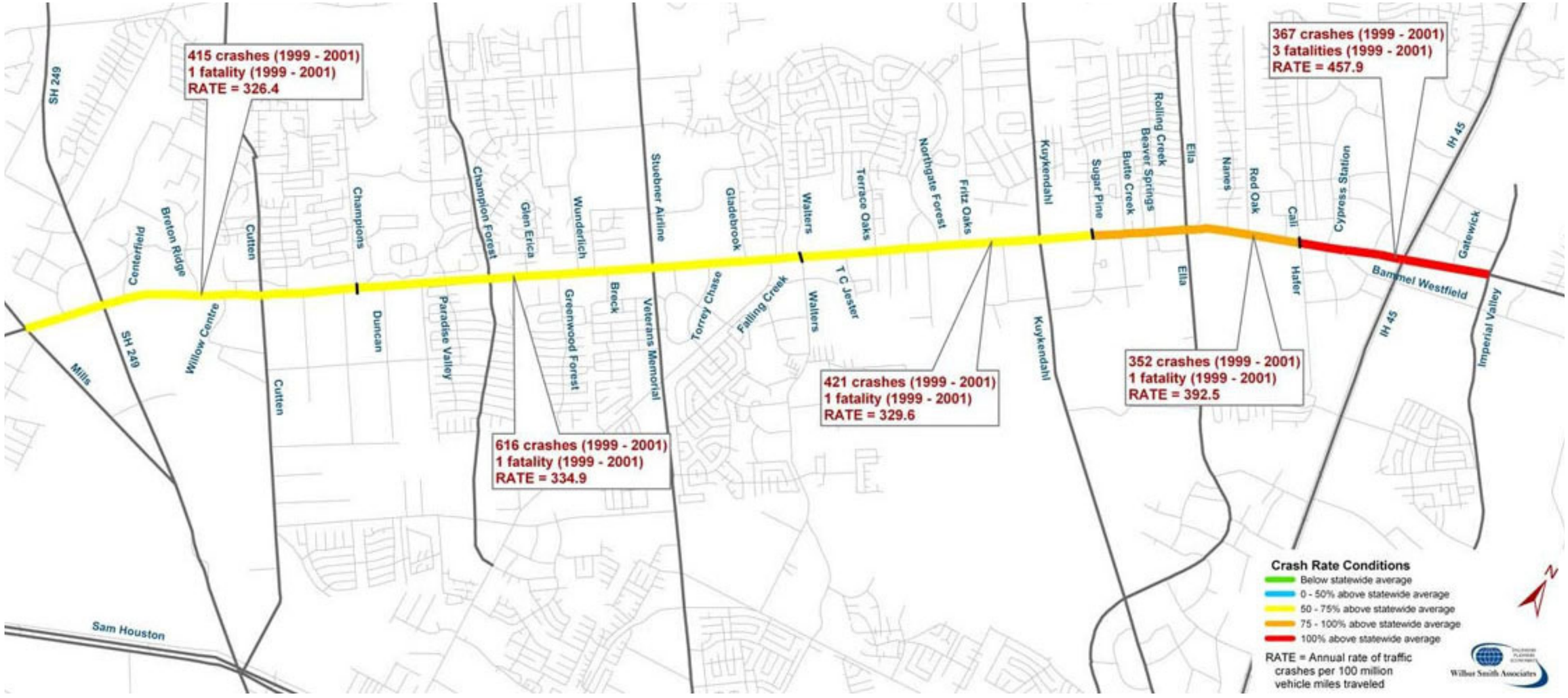


Figure 2.3: Crash rate conditions

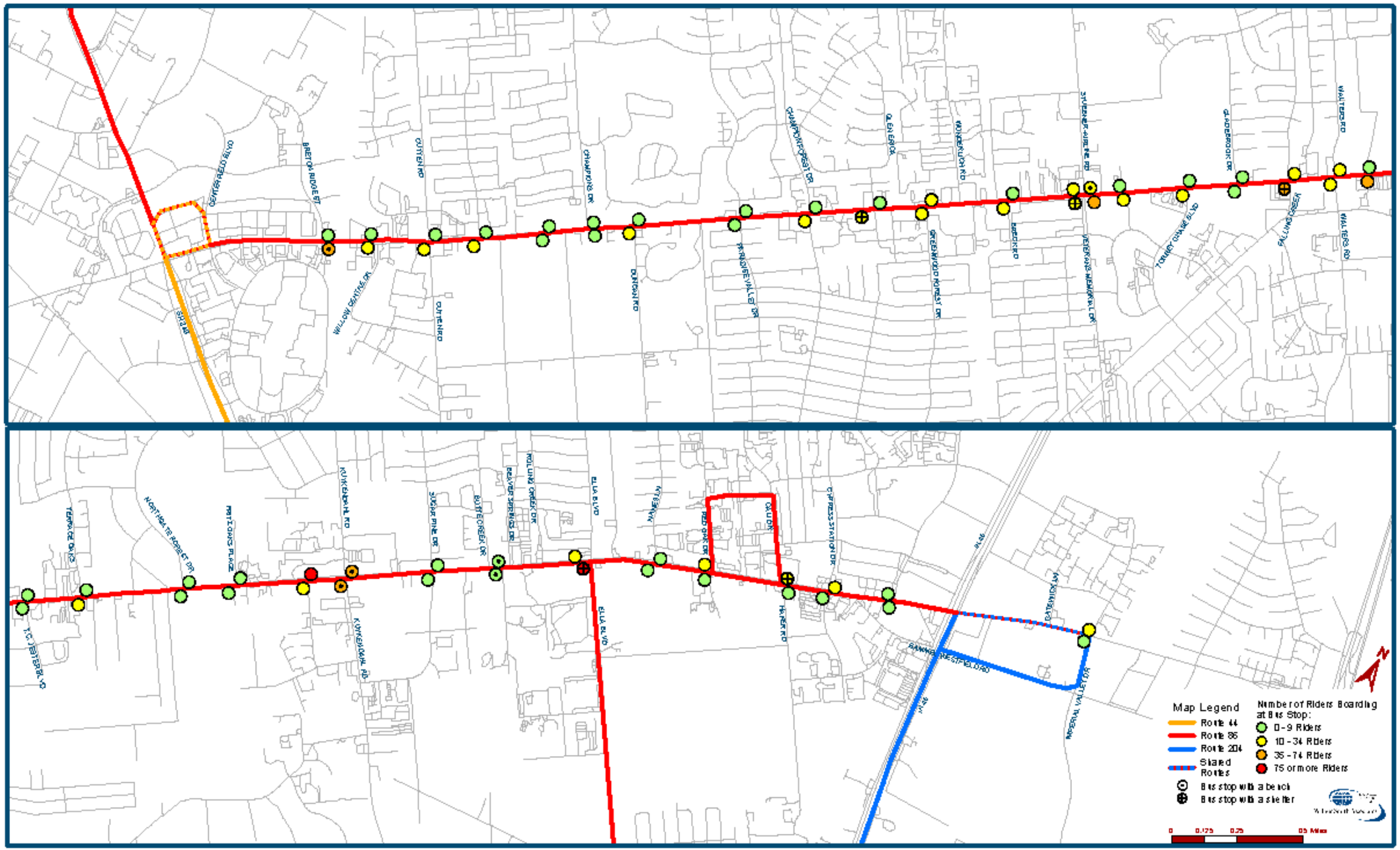
Note:

The Injury crashes category includes all crashes reported as incapacitating and non-incapacitating injury and possible injury crashes.

Transit Service

METRO operates three bus routes in the vicinity of the FM 1960 corridor. METRO operates Route 86 (FM 1960 Circulator) along FM 1960, providing service from Hewlett Packard on SH 249 to North Harris College and Greenspoint Mall. Route 44 runs from Willowbrook Mall along SH 249 south to the Acres Homes Transit Center. Route 204 runs along IH 45 from Spring Park and Ride to Jefferson & Smith. Bus stops at Glen Erica, Veterans Memorial, Falling Creek, Kuykendahl, Beaver Springs, and Cali/Hafer are equipped with shelters for patrons. A bus stop inventory was conducted in October 2003. Figure 2.4 identifies existing bus stop facilities, as well as number of boardings per day. According to METRO guidelines, bus stops with 10 or more boardings per day should have benches; stops with 35 or more boardings per day should have shelters; and, stops with 75 or more boardings per day should have double shelters. Bus stop locations with significant levels of bus boardings and associated pedestrian activities include Bammel Village, Kuykendahl, and Ella.

Figure 2.4: Existing transit rider boarding at bus stops



Driveway Access to Development

The driveway density or number of connecting driveways varies with the level of commercial development along the study section. The FM 1960 corridor has a significant amount of commercial development. For example, the section between Mills Road and Cutten Road has a driveway density of 34 driveways per mile, and the section between Walters Road and Kuykendahl Drive has a density of 32 driveways per mile. One the other hand, the section between Cali/Hafer and Imperial Valley Drive with a higher concentration of commercial and other development has a density of 49 driveways per mile. As the driveway density increases, the number of turning conflicts increases and travel time decresases.

Sidewalks

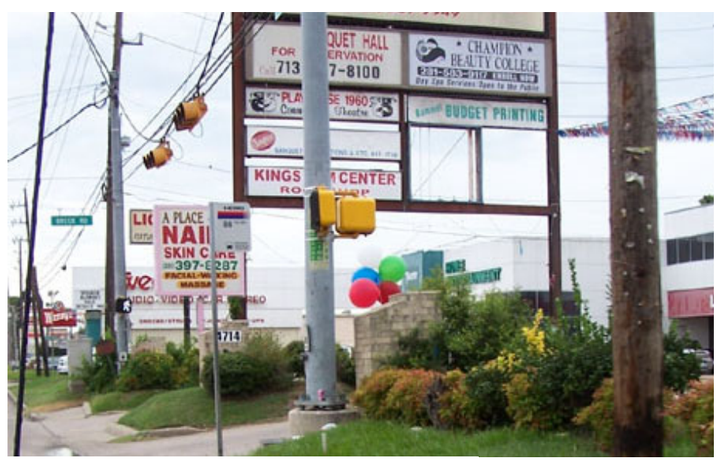
Sidewalks provide a safe way for pedestrians to commuter along a roadway. There are no continuous sidewalks along FM 1960. The space between the back of the curb and the right-of-way line is approximately eight feet and generally has grassy swales with drainage and utilities under ground. There are a number of man-made paths, which are indicative of heavy pedestrian movement along certain sections of FM 1960. Most of the man-made paths are from an intersection to a bus stop. While sidewalks do exist sporadically along FM 1960, including around the Kuykendahl, Champions Drive and Greenwood Forest areas, the only two locations within the project limits that have purposeful sidewalks are Breton Ridge to SH 249 in the vicinity of Willowbrook Mall and between IH 45 and Cypress Station. Pedestrian controlled signals exist at every major intersection along FM 1960.

Signage

The roadway signage along FM 1960 provides adequate information to roadway users but is marred by the volume and poor quality of commercial signs along the corridor. Advanced signage is in place, which alerts users to approaching cross streets; however, the street signage does not contain block numbers, which would aide the roadway user in decision making.

Walking path worn in grass

Inlet for underground drainage system inside right-of-way



Cluttered signage along roadway

Planned Projects in the Area

The team conducted an evaluation of the various transportation agencies' proposed transportation projects, which may impact FM 1960. Figure 2.5 depicts the status of the proposed projects and their impact on FM 1960.

Aside from maintenance and operation, neither TxDOT nor METRO have proposed improvements in the general project vicinity.

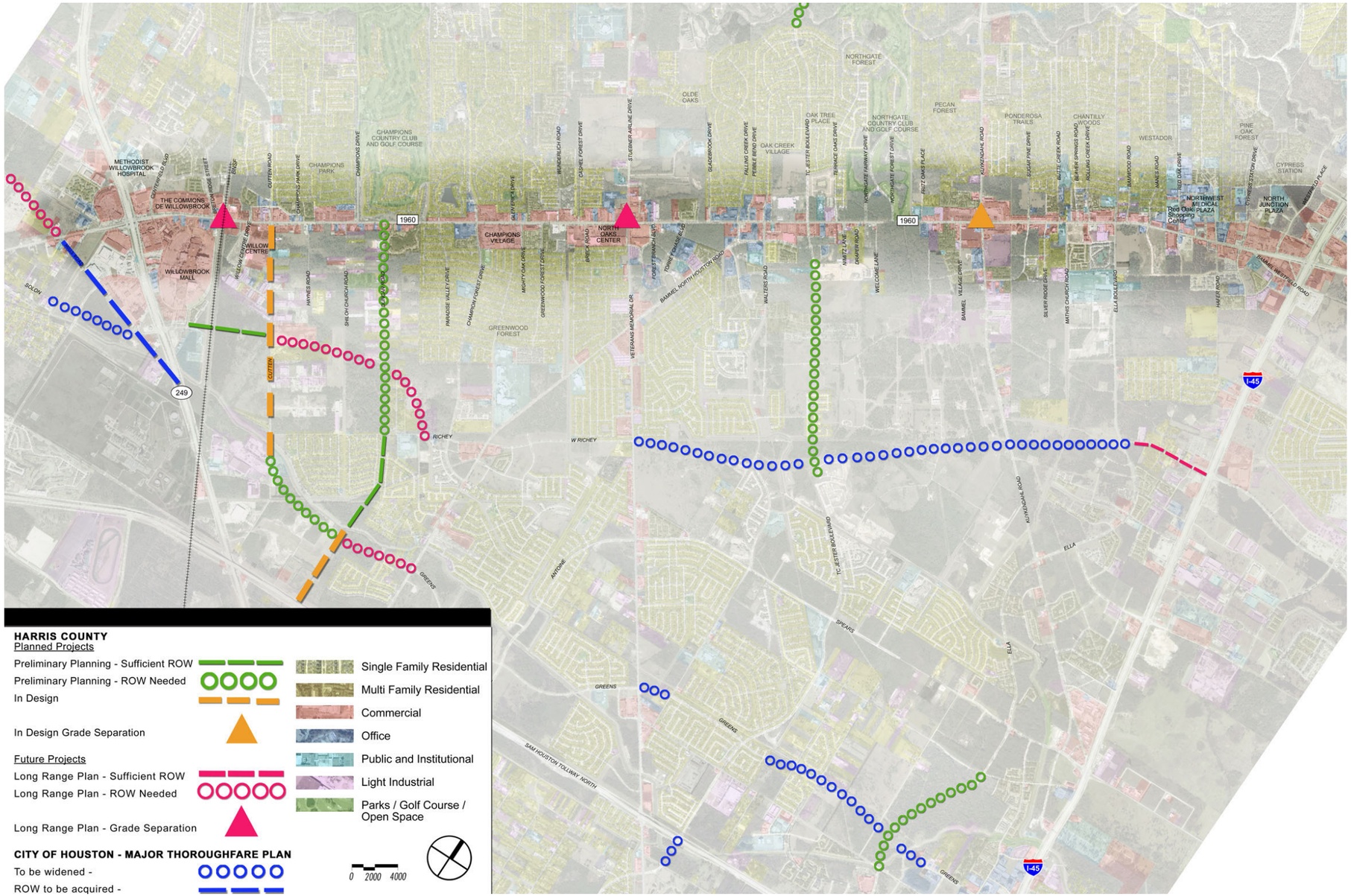


Figure 2.5: Planned projects in the area

SECTION 3

PUBLIC INVOLVEMENT

Public involvement is a fundamental part of any access management study. A three-way approach to public involvement was developed for the FM 1960 Access Management Study. A contract steering committee was formed, two public meetings were conducted and two stakeholders meetings were held. In addition, a website was developed under the address www.fm1960mobility.com to keep the public abreast of current project progress. The study team also participated in several speaking engagements to update members of the North Houston Association, Houston Northwest Chamber of Commerce and the FM 1960 Area Alliance on the status of the project.

Contract Steering Committee

The Contract Steering Committee was comprised of the Houston-Galveston Area Council, Texas Department of Transportation and Harris County as funding partners in cooperation with local match contributors: Houston Northwest Chamber of Commerce and the North Houston Association. In addition to these entities, the Metropolitan Transit Authority, City of Houston and the FM 1960 Area Alliance also participated in the Contract Steering Committee Meetings.

The purpose of the Contact Steering Committee was to direct the technical development of the study and to provide the consultant team with technical representation from each of the entities that are impacted by the study.

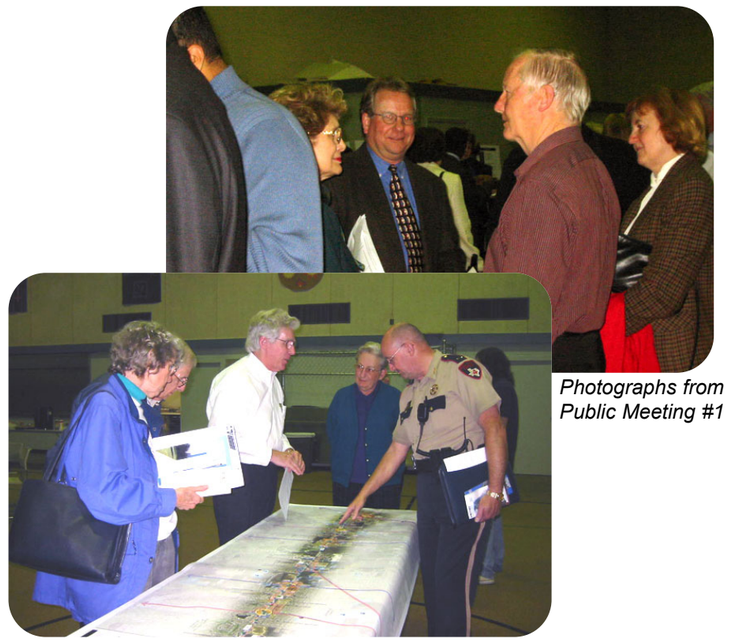
Public Meetings

Two public meetings were held as part of the FM 1960 Access Management Study. The first public meeting was designed to present the goals and objectives of the study as well as the existing conditions and data collection to the public and to gather information from the public regarding their recommendations for improvements.

The second, and final, public meeting was conducted to solicit public input on the proposed recommendations. Both public meetings were held at Northwoods Presbyterian Church, located centrally in the study area at the corner of FM 1960 and TC Jester Boulevard.

The first public meeting was held on January 15, 2004. Of the 140 individuals that attended the meeting, 118 completed questionnaires at or in the days following the public meeting. The questionnaires were tabulated and the summary report was given to the Contract Steering Committee and posted on the project website.

The second public meeting was held on June 17, 2004. 72 individuals attended and 48 comment forms were collected during the open comment period, which ended July 15th. The comment forms were compiled into a summary report and a response document was prepared. Both documents were given to the Contract Steering Committee and posted on the project website. Excerpts from both public meetings can be found on the following pages.



Photographs from Public Meeting #1

Goals for Public Involvement:

To ensure a public involvement program that is comprehensive in nature and addresses the unique aspects of the FM 1960 project, there are four guiding principles with which the study team adheres:

1. Identify and involve all stakeholders in the study process
2. Be proactive
3. Bring diverse interests to the table
4. Build consensus

Using these four principles, the HNTB team has established public involvement goals to ensure the activities have purpose and serve as principles to guide the public involvement process as it is planned and executed. Goals for the FM 1960 Access Management Study are as follows:

1. Increase the level of awareness about the traffic issues and problems
2. Provide opportunities for businesses, residents and other constituencies with interest in the corridor to provide input into the study process
3. Provide a method for incorporating input into the technical recommendation
4. Provide a mechanism for relaying study findings and recommendations to the public
5. Develop a platform and constituency for future discussion and consensus building

Excerpts from Public Meeting #1

Top three priorities for the FM 1960 corridor:

1. Improved traffic flow
2. Motorist safety
3. Improvements to intersections

Driveways:

The public was very supportive of shared and/or consolidated driveways with nearly 80 percent of respondents indicating that shared and/or consolidated driveways were acceptable.

Ninety six percent of respondents said there are too many driveways along FM 1960.

Signals:

Ninety nine percent of respondents supported better signal synchronization.

Raised Medians/Left Turn Bays:

Nearly 75 percent of respondents said that raised medians, left turn bays and/or landscaped medians were acceptable.

Right Turn Bays:

More than 95 percent of respondents supported the creation of right turn bays in strategic locations along the FM 1960 corridor.

Excerpts from Public Meeting #2

Overall the feedback was positive regarding the proposed improvements. One of the primary concerns was the proposed raised medians and their perceived effect. In general, most respondents were receptive to raised medians just not at specific designated businesses and/or neighborhoods. Concern was expressed in general for the impact raised medians might have on emergency vehicles. In addition, some concern was expressed regarding the proposed removal of certain specific signals.

Response to Project Recommendations

Positive feedback/supportive of recommendations:	10
Generally support - have some specific changes	22
Opposed to certain elements in specific locations	7
Opposed to most/all of the proposed improvements:	9

Stakeholders Meetings

The team took a two-pronged approach to addressing stakeholders' concerns in the corridor. At the onset of the study, and after Public Meeting #1, the team met with key stakeholders in the corridor to discuss specific potential impacts that may result from the study.

The second stakeholder meeting was conducted using the North Houston Association's Transportation Committee, which is comprised of numerous private-sector civil engineers as well as transportation agency staff. The team presented the proposed recommendations, prior to Public Meeting #2, and asked for feedback from the committee. The comments were reviewed and changes were made accordingly.

Photographs from Public Meeting #2

SECTION 4

ACCESS MANAGEMENT TOOLS

According to the Federal Highway Administration, access management is the process that provides access to land development while simultaneously preserving the flow of traffic on the surrounding system in terms of safety, capacity and speed.

The general principles of access management include:

- limiting conflict points
- separating or properly spacing conflict points
- removing slower vehicles from through lanes

In practical terms, Access Management is controlling the number of conflict points encountered without hindering access to properties and removing turning vehicles from the roadway as efficiently as possible.

Why Access Management

It is incumbent upon transportation agencies to effectively manage their transportation system in order to extend the life of the infrastructure, reduce congestion, improve air quality, promote public safety, and maintain or improve the appearance and overall quality of the system and surrounding areas. Access management provides for effective movement of people and goods to businesses, commercial and residential developments thereby aiding economic development and growth, preserving land values and spurring redevelopment.

BENEFITS OF ACCESS MANAGEMENT

Public - faster and safer travel

Businesses - improved corridor vitality

Taxpayers - more efficient existing infrastructure

Agencies - low cost improvements

The Tools

Access management is accomplished through a number of strategic measures aimed at improving mobility and safety; these measures include:

- median treatments
- left turn bays/deceleration lanes
- right turn bays/deceleration lanes
- turn bay extensions/dual turn lanes
- driveway improvements and spacing
- signal synchronization
- traffic signal and intersection spacing
- internal property circulation and connections
- multi-modal opportunities and amenities
- supporting street network

Median Treatments

Three types of median treatments exists along roadways, these include:

No median - This double center stripe treatment is typically found on low volume, two or four lane undivided roadways. Potential problems include uncontrolled conflict points, higher crash rates and no refuge for stopping vehicles, buses or pedestrians.

Flush median with continuous left turn lane - While safer than a roadway with no median, the uncontrolled conflict points in the center turn lane result in higher crash rates and numerous curb cuts. This treatment is recommended for two and four lane roadways with traffic volumes between 24,000 and 28,000 vehicles per day.

Flush median with continuous left turn lane along FM 1960

Raised median with channelized median openings - divided roadway providing access and left turns at designated locations; it is safer than undivided or flush median roadways. The treatment generally is recommended for roadways that have four or more lanes and carry more than 28,000 vehicles per day.

PURPOSE OF MEDIANS

- Separate opposing traffic
- Provide refuge for pedestrians & crossing vehicles
- Offer opportunities for landscape enhancements
- Allow space for turning vehicles
- Limit the conflict points
- Control movements from adjacent properties

Left Turn Bays/Deceleration Lanes

A left turn bay serves as a deceleration and storage lane providing a safe refuge for vehicles turning left, which minimizes the impact on through traffic.

Right Turn Bays/Deceleration Lanes

Right turn bays increase roadway capacity and provide a refuge for slower right turning vehicles thereby improving safety and minimizing the delay to through traffic. The downside to implementation of a right turn bay is that it requires new pavement and, in many cases, additional right-of-way.

Example of raised, landscaped median along Westheimer corridor

Turn Bay Extensions/Dual Turn Lanes

Extension of an existing right or left turn lane and/or the addition of a second turn lane may be required to provide more storage capacity when turning volumes are extremely high. This will ensure that turning traffic does not queue into advancing traffic lanes.

Driveways

Vehicles turning in and out of driveways block or slow through moving traffic. Direct access driveways should be discouraged on strategic or principal arterials. When access must be provided, consideration should be taken to maintain adequate spacing distance. Appropriate distance between driveways and intersections is directly related to the roadway speed, as shown in Table 4.1. When possible, driveways should be shared by adjacent developments.

Speed (mph)	Driveway before Intersection (feet)	Driveway after Intersection (feet)
30	225	200
40	395	305
50	570	425

Table 4.1: Recommended Driveway Clearance

Source: Access Management Manual TRB, 2003

DRIVEWAY FACTORS THAT AFFECT TRAFFIC FLOW

- Number of driveways/conflict points
- Turning radii
- Steep driveway slopes
- Corner clearance
- Sight distance

Signal Synchronization

Synchronization of the traffic signals along a roadway allows continuous progression of vehicles at a planned rate of speed; however, a balance must be achieved between capacity and progression requirements. The green time per signal cycle should be maximized for arterial roadways that experience high traffic volumes and longer cycle lengths should be implemented during peak hours to accommodate added vehicle capacity.

Signal & Intersection Spacing

Consistent spacing of traffic signals is desirable to allow efficient progression of vehicles. Signal spacing of 1/2 mile is desirable for roadways with high traffic volumes. Progression with a combination of speed and cycle length cannot be achieved with less than a 1/4 mile spacing between signals. Frequent and/or inconsistent spacing of signals will result in poor traffic flow and excessive delays and congestion.

Internal Property Circulation and Connections

Internal connections between private properties allow vehicles to circulate between businesses without having to re-enter the roadway, reducing traffic on the primary roadway and increasing safety. Joint access improves customer convenience as well as provides for more efficient emergency and delivery vehicle access. The result is a positive benefit to business by providing easy access from one site to another. Adjacent properties under single ownership can easily be retrofitted to include consolidated driveways and shared parking/internal circulation. Coordination and agreement will be required between multiple property owners.

Multimodal Opportunities and Amenities

Multimodal options that support walking, bicycling and transit use and their supporting facilities are important planning tools in developing a robust transportation environment. A multi-modal corridor provides alternatives to the vehicle-dependent developments that are common in the Houston area. A concentrated mix of land uses connected by a network of streets and sidewalks within walking distance to transit stops provides an ideal scenario for on-going growth and quality development.

Supporting Street Network

A supporting street network of local and collector streets is critical to a well-planned community and roadway system. Interconnected streets and circulation systems support alternative modes of transportation and provide alternative routes for vehicles as well as bicycles and pedestrians.

OTHER IMPROVEMENT TOOLS

- Block numbers on street signs
- Enhanced pavement markings
- Add back panels to signal heads
- Provide advanced sign information
- Define the roadway with landscaping
- Link communication systems between agencies

SECTION 5

RECOMMENDED IMPROVEMENTS

Recommended geometric and operational improvements were selected based on three primary criteria: mobility, access, and safety. Mobility improvements are those that tend to reduce travel delays, improve travel time, and provide better traffic signal progression. Access improvements are those designed to enhance access to adjacent land uses or improve internal circulation within or between adjacent developments. Safety improvements strive to reduce crashes by improving operational elements, decreasing conflict points and reducing driver confusion.

Many of the recommended improvements are contained within the existing right-of-way and do not require extensive engineering or disruptive construction. These improvements are considered short-range recommendations. Other improvements requiring more extensive coordination with property owners, acquisition of right-of-way, more detailed engineering or utility adjustments are included in the medium- and long-range recommendations. In order to achieve the maximum benefit from the recommended Access Management measures, the medium-range improvements should be implemented with the short-range improvements if possible.

This section identifies the types and locations of the recommended improvements along the FM 1960 corridor. A description of the proposed improvements is located in the adjacent shaded box and the geometric improvement types are illustrated on the next few pages followed by the layout sheets depicting the location of the improvements on an aerial map.

Other general improvement recommendations not depicted graphically include: signal synchronization, EMS signal preemption, overhead street signs with block numbers, back plates for EB/WB facing signals to reduce glare, communication coordination improvements between TxDOT and Harris County's traffic systems, new pavement striping and grade separation improvements at the BNSF railroad at FM 1960 and at Stuebner Airline and FM 1960.

A listing of the improvements in the short-, medium- and long-range categories is included after the layouts. Each category includes a summary table of the improvements by type and agency responsibility.

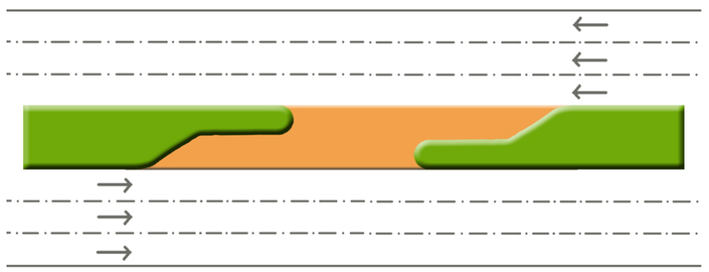
SUMMARY OF IMPROVEMENT TYPES

- **A:** **Traffic Signal Improvement** - Signal removal or modification
- **B:** **Median Improvements** - Closure, channelization, extension of left turn lanes
- **C:** **Other FM 1960 Improvements** - Left/right turn lanes and extensions, miscellaneous
- **D:** **Cross Street Improvements** - Left/right turn lanes and extensions
- **E:** **Driveway Improvements** -
  Minor: includes increasing turn radii, channelizing, increasing throat length and closing
  Major: includes relocating, consolidating and improving slope
- **F:** **Private Property Improvements** - Connecting properties and improving internal circulation
- **G:** **New Roadway** - Refers to backage streets to improve internal circulation
- **H:** **Bus Stop Improvements** - Add benches, shelters and sidewalks from intersection to bus stop
- **I:** **Signage Improvements** - Add guide signs

Shaded Green Area - Opportunity for landscape enhancements

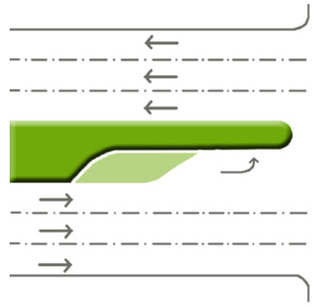
B1: Median Closure

Serves to minimize the number of conflict points and through lane blockage, thus increasing through lane capacity, traffic flow and safety.



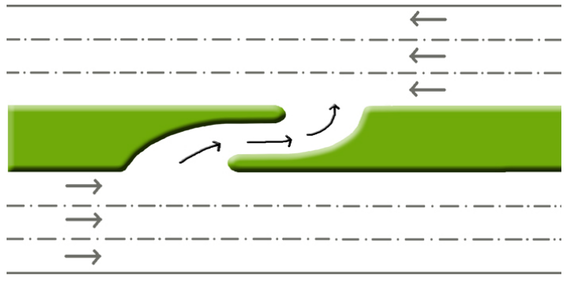
B2: Left Turn Lane Extension

Serves to increase storage capacity and reduce through traffic interference at location with high left turn volumes.



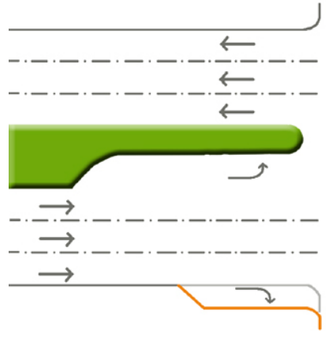
B4: Channelized Left Turn Lane

Serves mainly to reduce median blockage and conflict points at median crossings by restricting left turns to one direction.



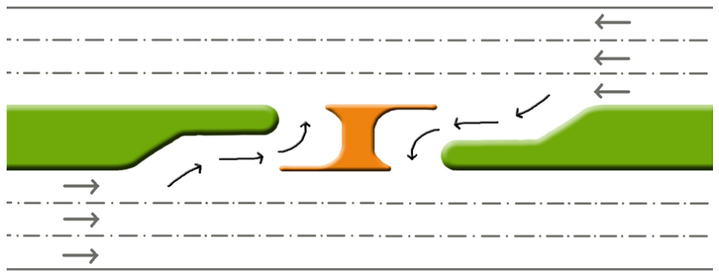
C1 & D3: Right Turn Lane Addition

Serves to provide storage and/or a deceleration lane for right turn vehicles without impeding the flow of through traffic.



B3: Two Directional Channelized Median

Serves mainly to reduce median blockage and conflict points at median crossings by restricting left turns to one or both directions from the main street and prohibiting cross traffic from driveways from entering the median.

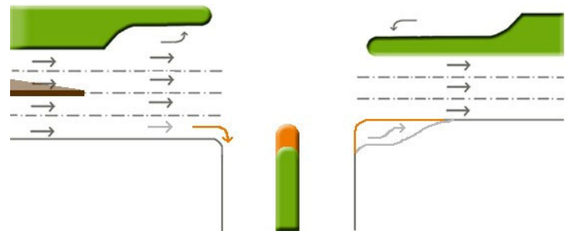


C3 & D1: Add Dual Left Turn Lanes

Serves to provide additional storage for left turning vehicles by separating left turning movements from through traffic.

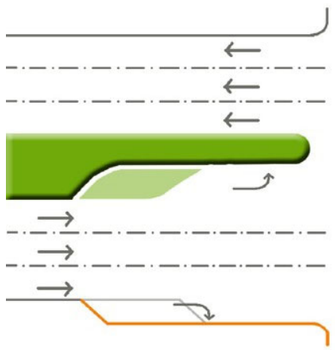
C5: Convert Through Lane to Right Turn Lane

Provides dedicated right turn lane and reducing weaving movements past the intersection.



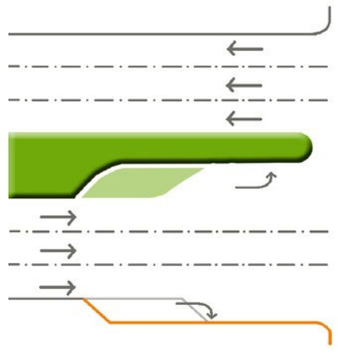
C2: Right Turn Lane Extension

Serves to extend storage capacity and reduce through traffic interference at locations with high right turn volumes.



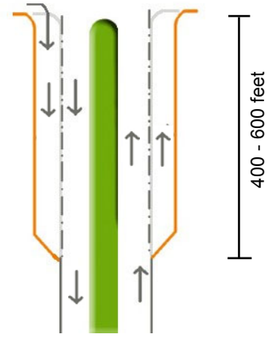
D4: Extend Existing Turn Bays

Serves to increase storage capacity and reduce through traffic interference at location with high left and right turning volumes.

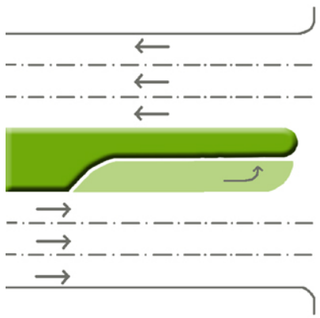


D5: Widen to Four Lanes 400-600 ft. from intersection

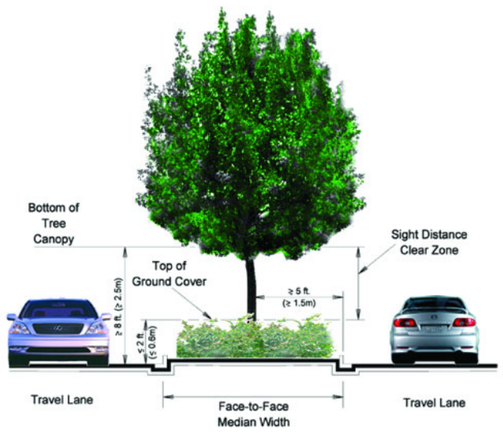
Improves capacity and allows for additional through and turning movement storage at intersection.



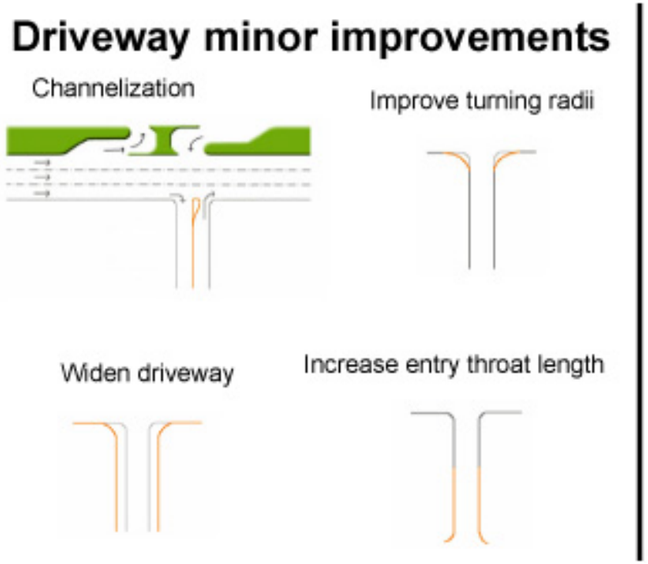
D2: Left Turn Lane Addition
Serves to provide storage for left turn vehicles without impeding the flow of through traffic.



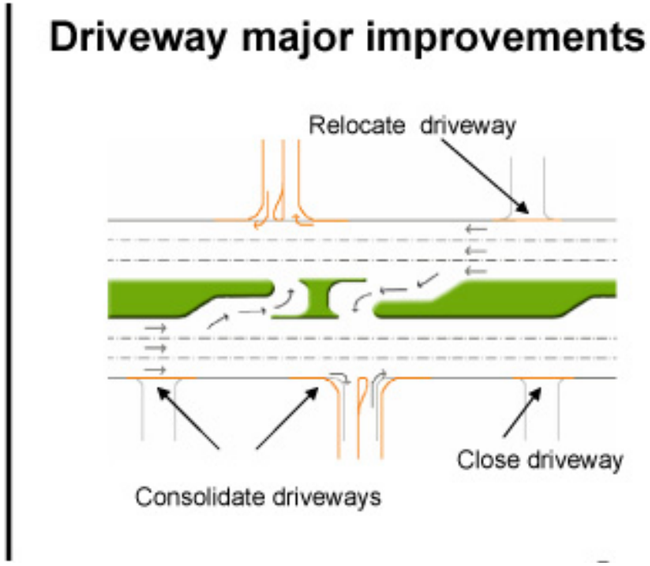
Shaded Green Area:
Opportunity for landscaping by others.



E 1: Minor Driveway Modification
Enhances mobility for through moving vehicles by improving the ingress and egress of turning vehicles.

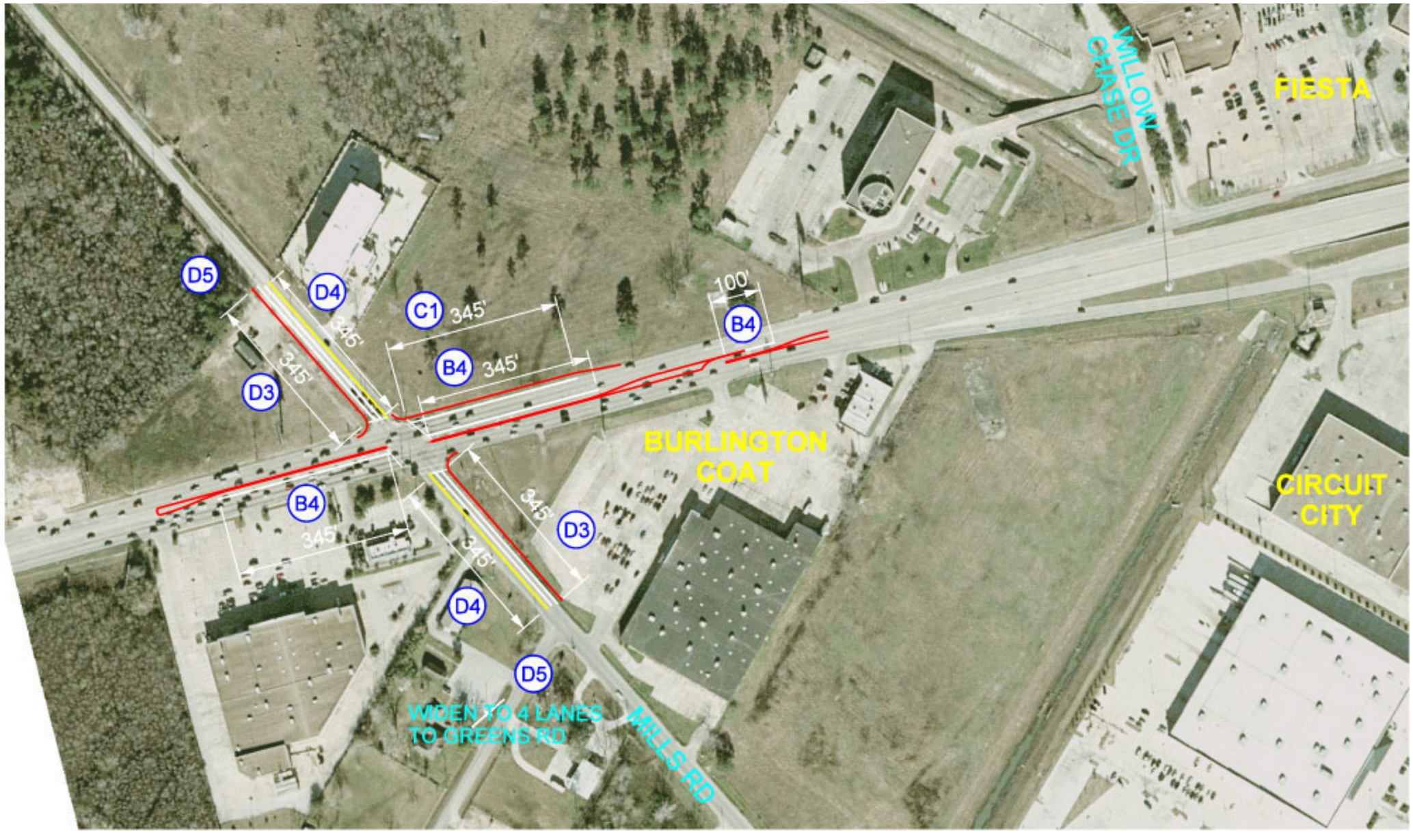


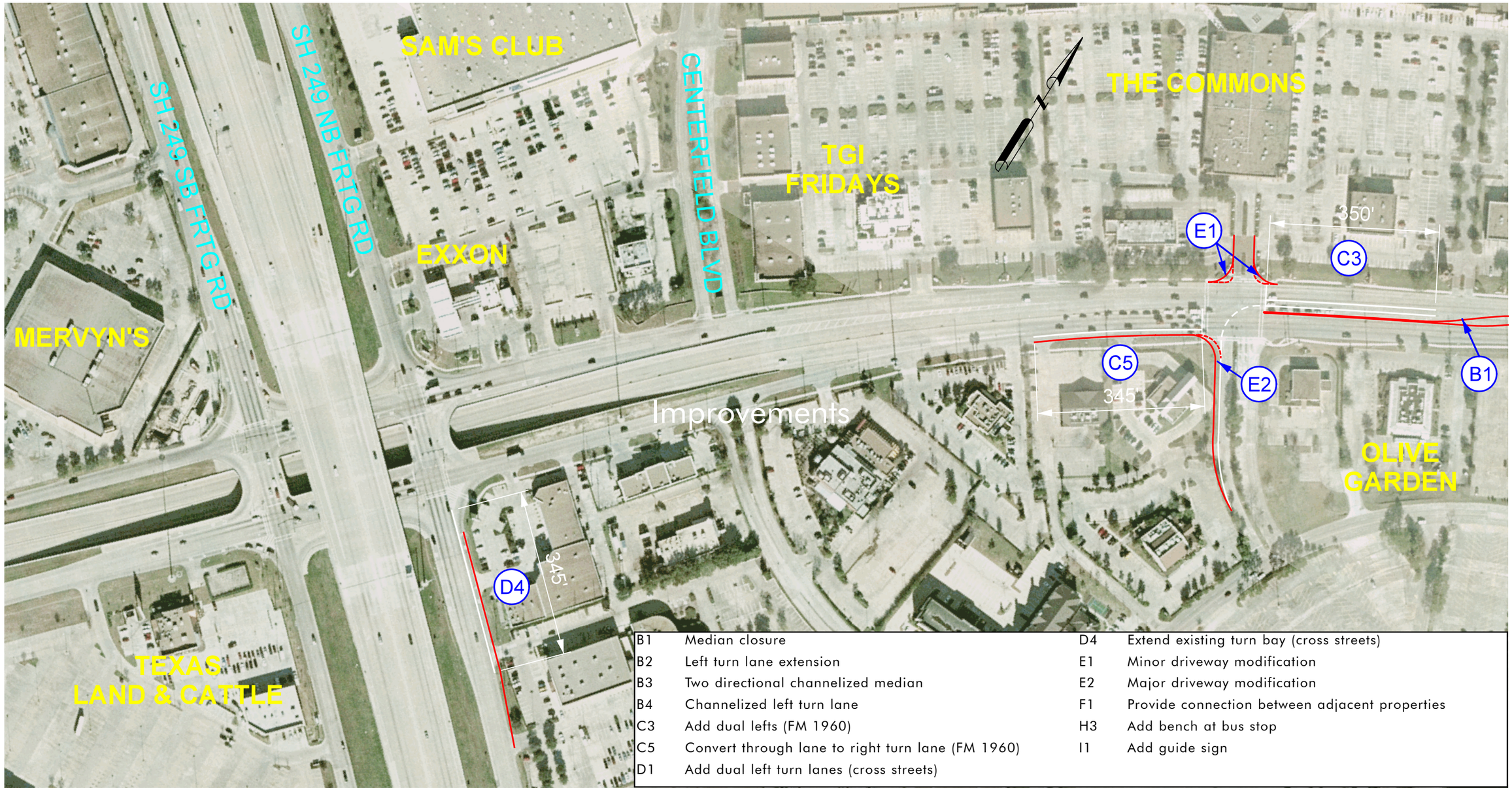
E 2 and E 3: Major Driveway Modification
Enhances mobility by minimizing and improving the number of curb cuts.



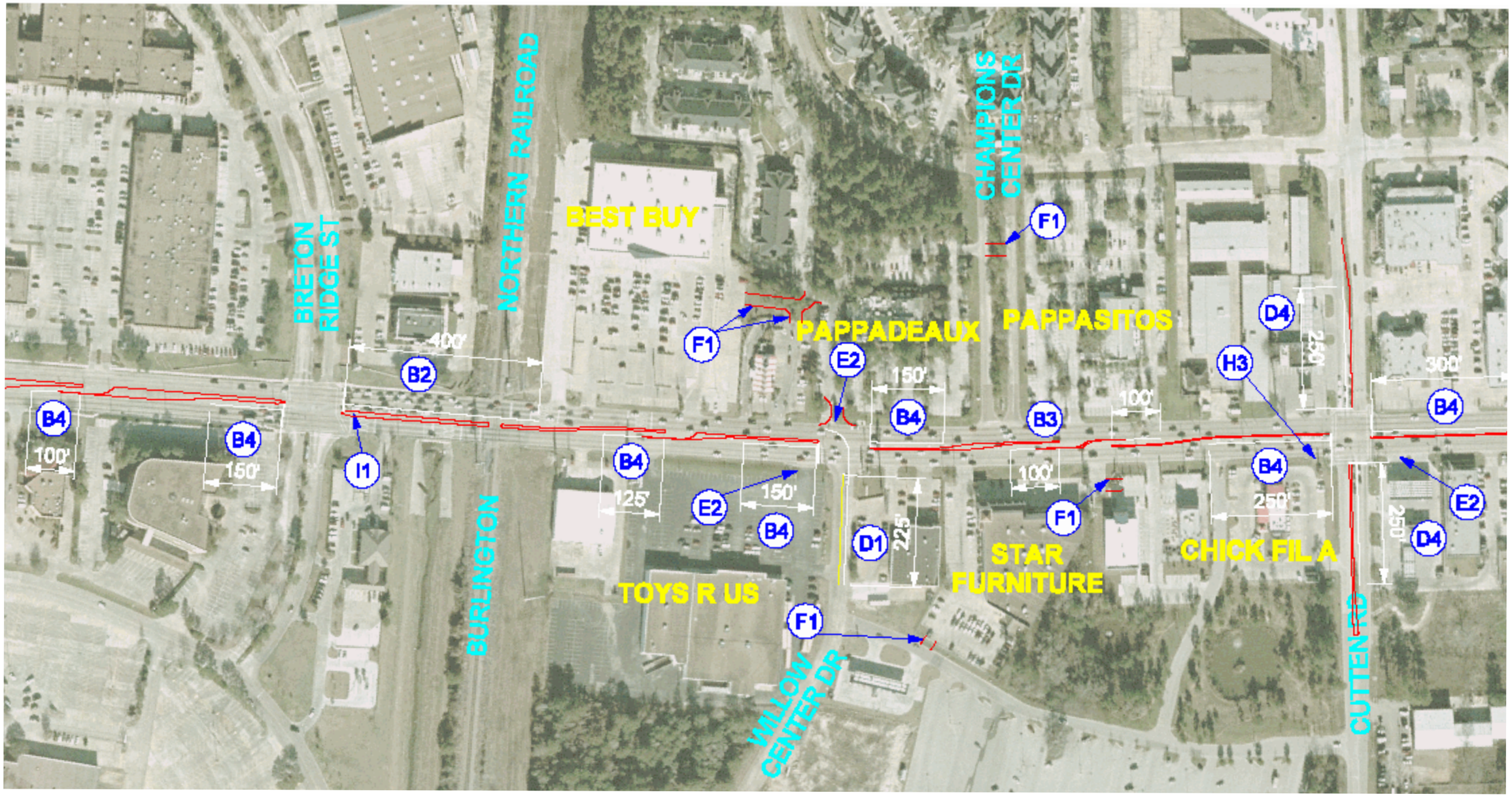
LEGEND

A1 Remove traffic signal
A2 Modify traffic signal
A3 Use single signal controller
B1 Median closure
B2 Left turn lane extension
B3 Two directional channelized median
B4 Channelized left turn lane
C1 Add right turn lane (FM 1960)
C2 Right turn lane extension (FM 1960)
C3 Add dual lefts (FM 1960)
C5 Convert through lane to right turn lane (FM 1960)
C7 Add sidewalks (FM 1960)
D1 Add dual left turn lanes (cross streets)
D2 Add left turn lane (cross streets)
D3 Add right turn lane (cross streets)
D4 Extend existing turn bay (cross streets)
D5 Widen cross street to four lanes, 400-600 ft. from FM 1960
E1 Minor driveway modification
E2 Major driveway modification
E3 Shared driveway
F1 Provide connection between adjacent properties
G1 New roadway
H1 Adjust bus stop location
H2 Provide sidewalk from bus stop to intersection
H3 Add bench at bus stop
H4 Add shelter at bus stop
I1 Add guide sign
I2 Add no left turn sign
Opportunity for landscaping


D5
D4
345'
C1
345'
100'
B4
D3
345'
B4
345'
BURLINGTON COAT
WILLOW CHASE DR
FIESTA
CIRCUIT CITY
B4
345'
345'
D3
345'
D4
D5
WIDEN TO 4 LANES TO GREENS RD
MILLS RD

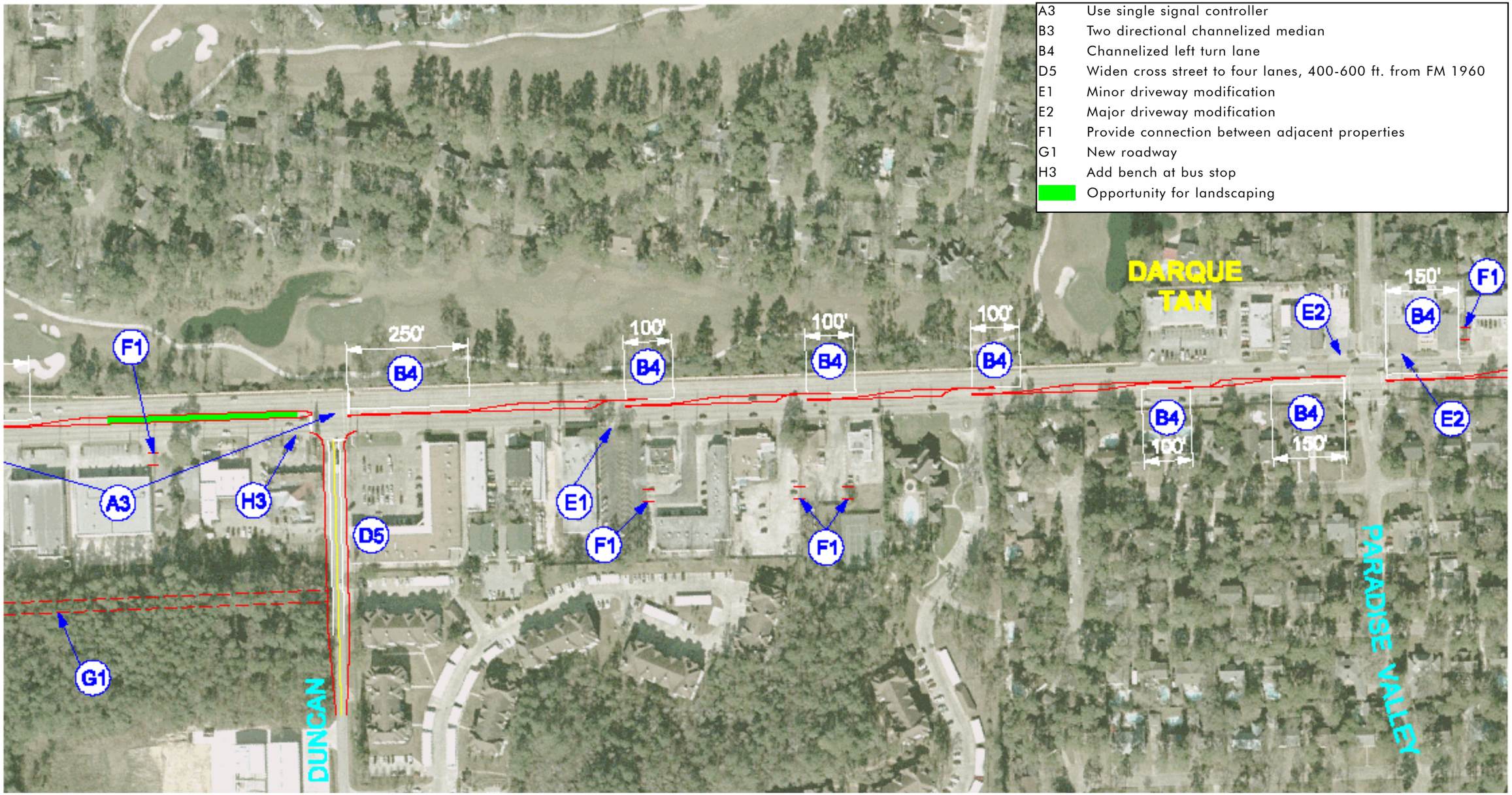


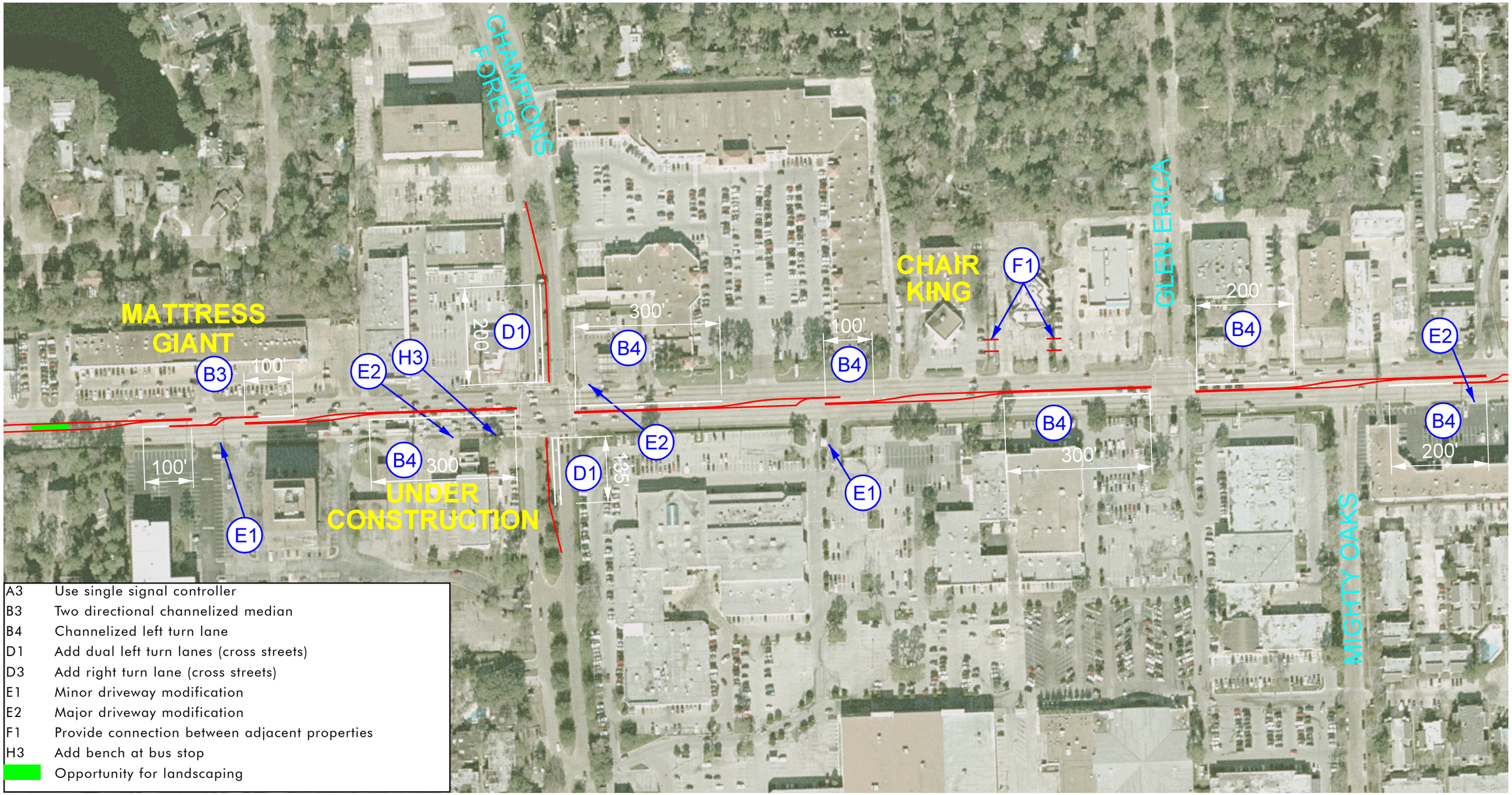
B1	Median closure	D4	Extend existing turn bay (cross streets)
B2	Left turn lane extension	E1	Minor driveway modification
B3	Two directional channelized median	E2	Major driveway modification
B4	Channelized left turn lane	F1	Provide connection between adjacent properties
C3	Add dual lefts (FM 1960)	H3	Add bench at bus stop
C5	Convert through lane to right turn lane (FM 1960)	I1	Add guide sign
D1	Add dual left turn lanes (cross streets)		

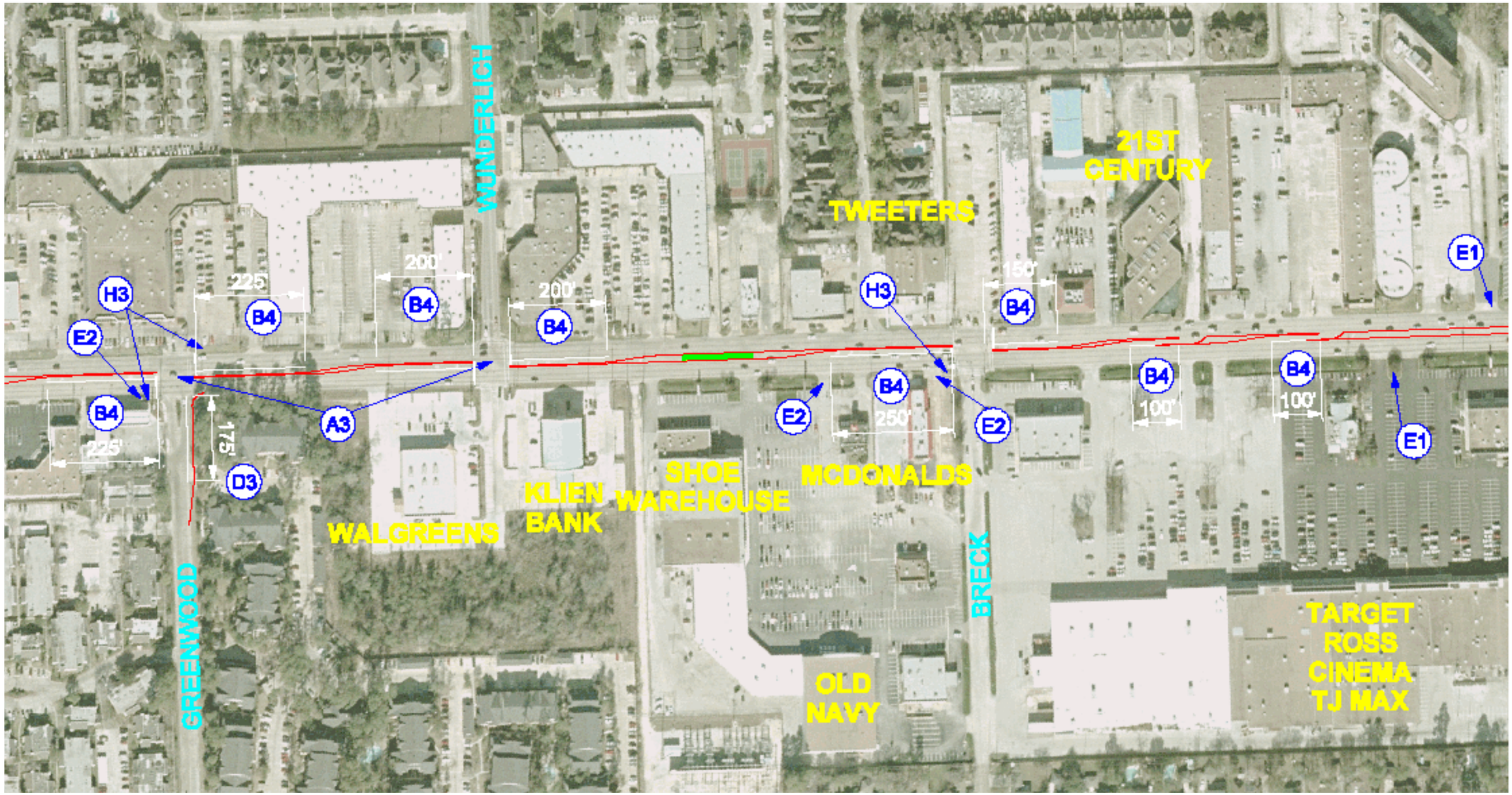

BRETON RIDGE ST
NORTHERN RAILROAD
BEST BUY
CHAMPIONS CENTER DR
PAPPADEAUX
PAPPASITOS
BURLINGTON
TOYS R US
STAR FURNITURE
CHICK FIL A
WILLOW CENTER DR
CUTTEN RD
F1
E2
H3
D4
B2
B4
B3
I1
D1
400'
150'
100'
125'
225'
250'
300'

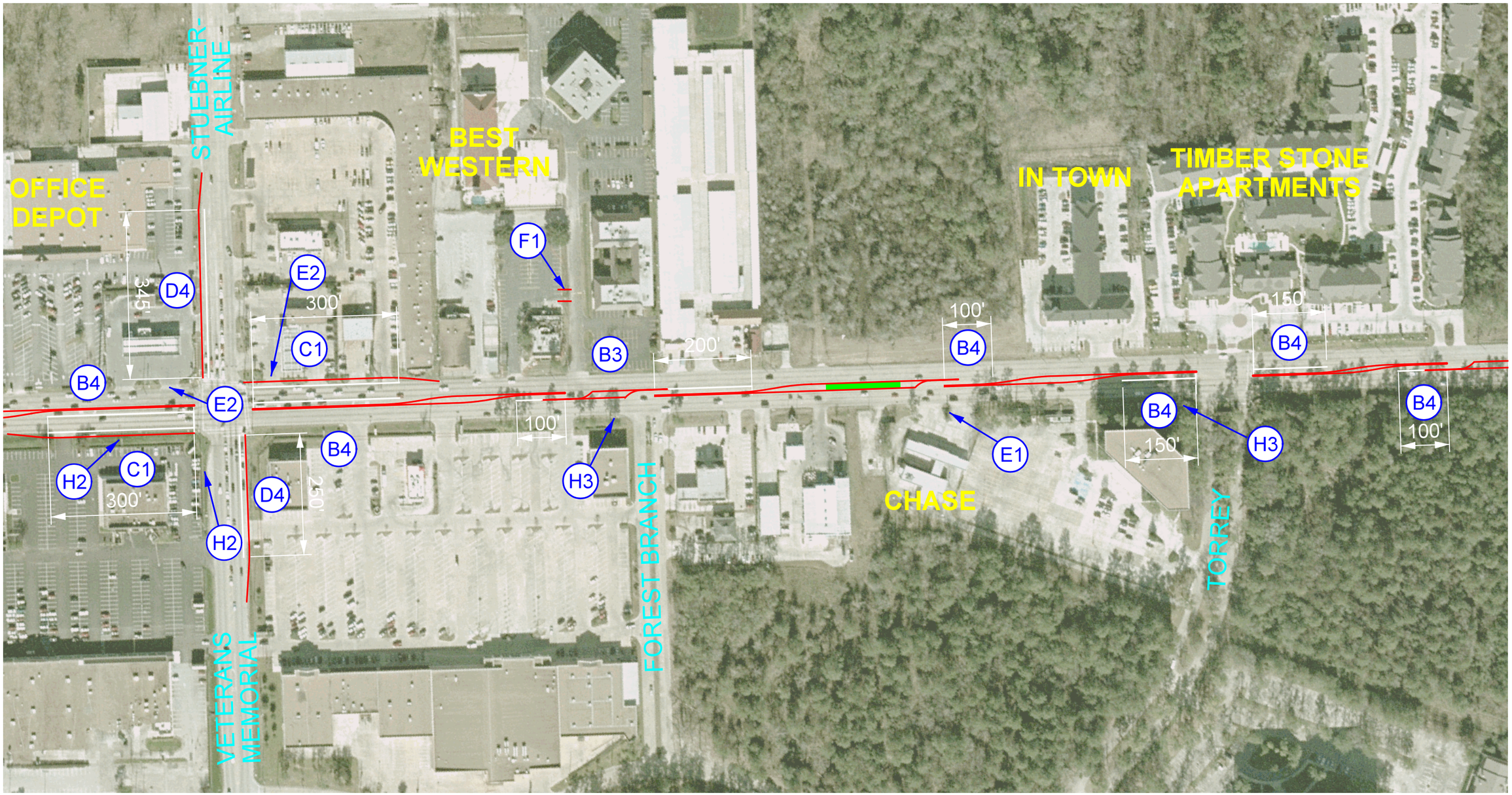

CAR WASH
F1
E2
100'
B4
E2
E1
H3
B4
100'
E2
B3
100'
B3
100'
E2
100'
WALGREENS
CHAMPIONS
D5
250'
B4
B4
250'
F1
STERLING BANK
TEXAS FIRST NAT'L BANK
HAYNES
SHILOH CHURCH

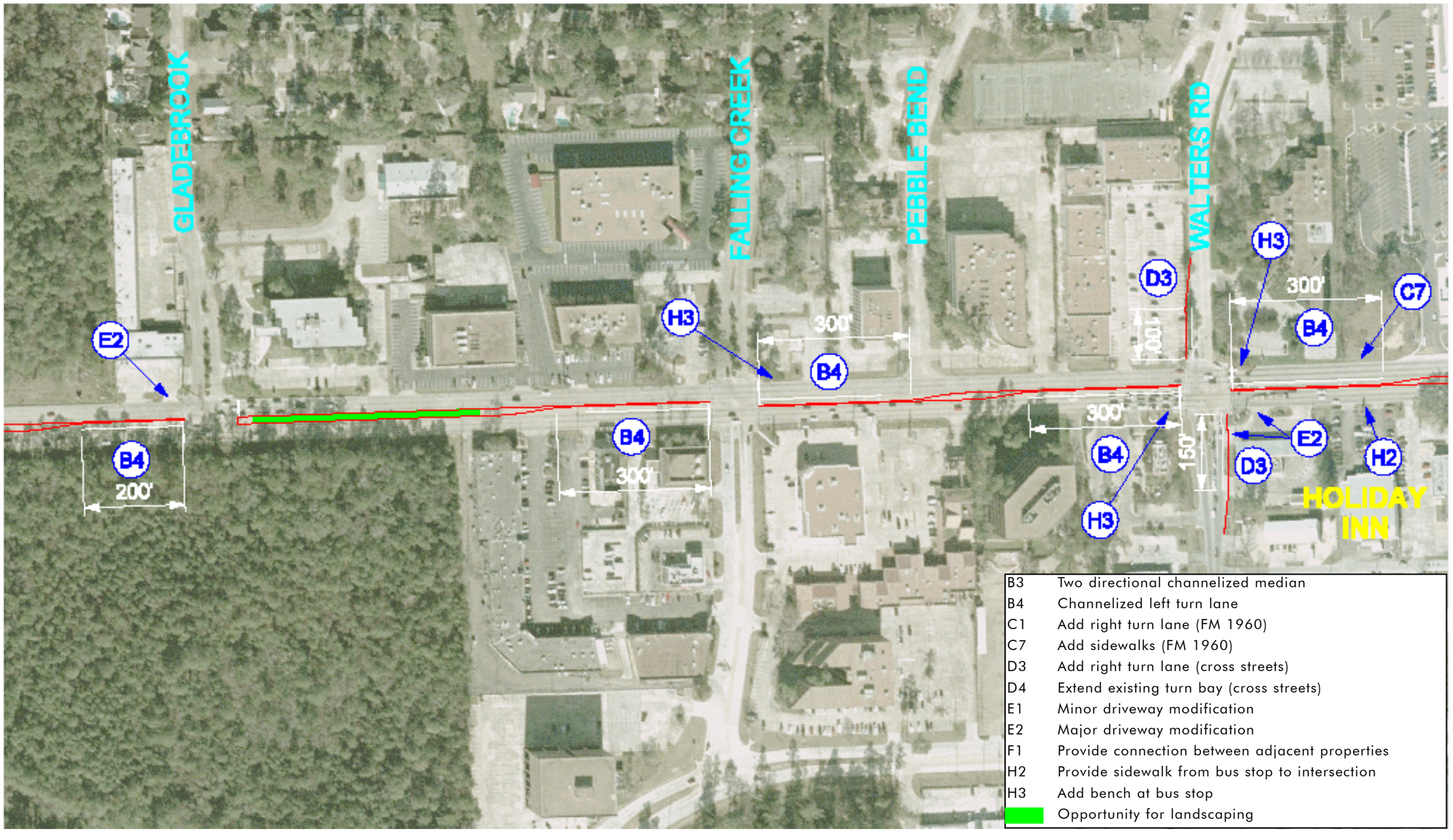
Improvements



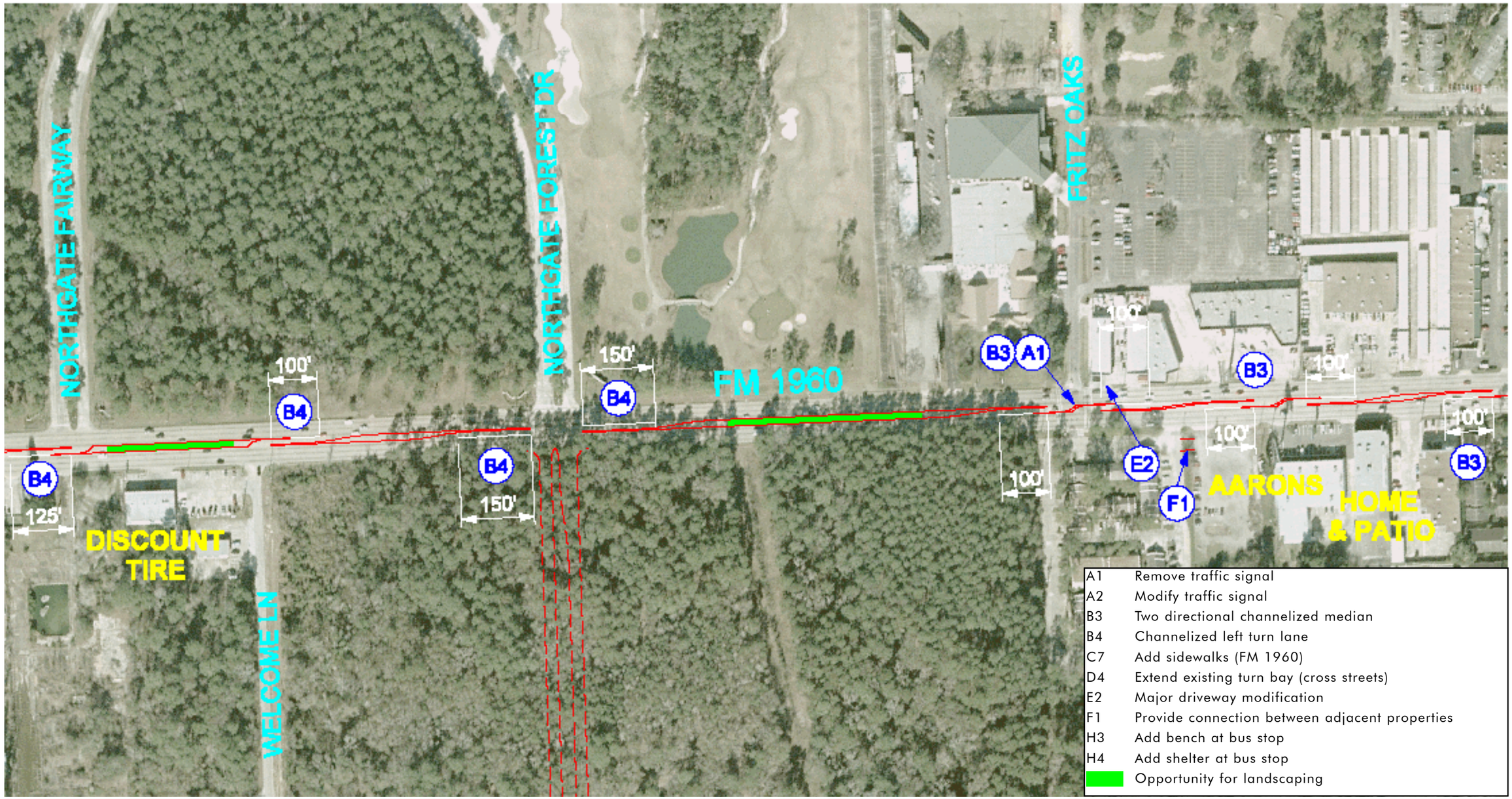

CHAMPIONS FOREST
MATTRESS GIANT
CHAIR KING
GLEN ERICA
MIGHTY OAKS
UNDER CONSTRUCTION
B3
100'
E2
H3
D1
200'
300'
B4
100'
B4
F1
200'
B4
E2
100'
B4
300'
E1
D1
85'
E2
E1
B4
300'
B4
200'
A3 Use single signal controller
B3 Two directional channelized median
B4 Channelized left turn lane
D1 Add dual left turn lanes (cross streets)
D3 Add right turn lane (cross streets)
E1 Minor driveway modification
E2 Major driveway modification
F1 Provide connection between adjacent properties
H3 Add bench at bus stop
Opportunity for landscaping

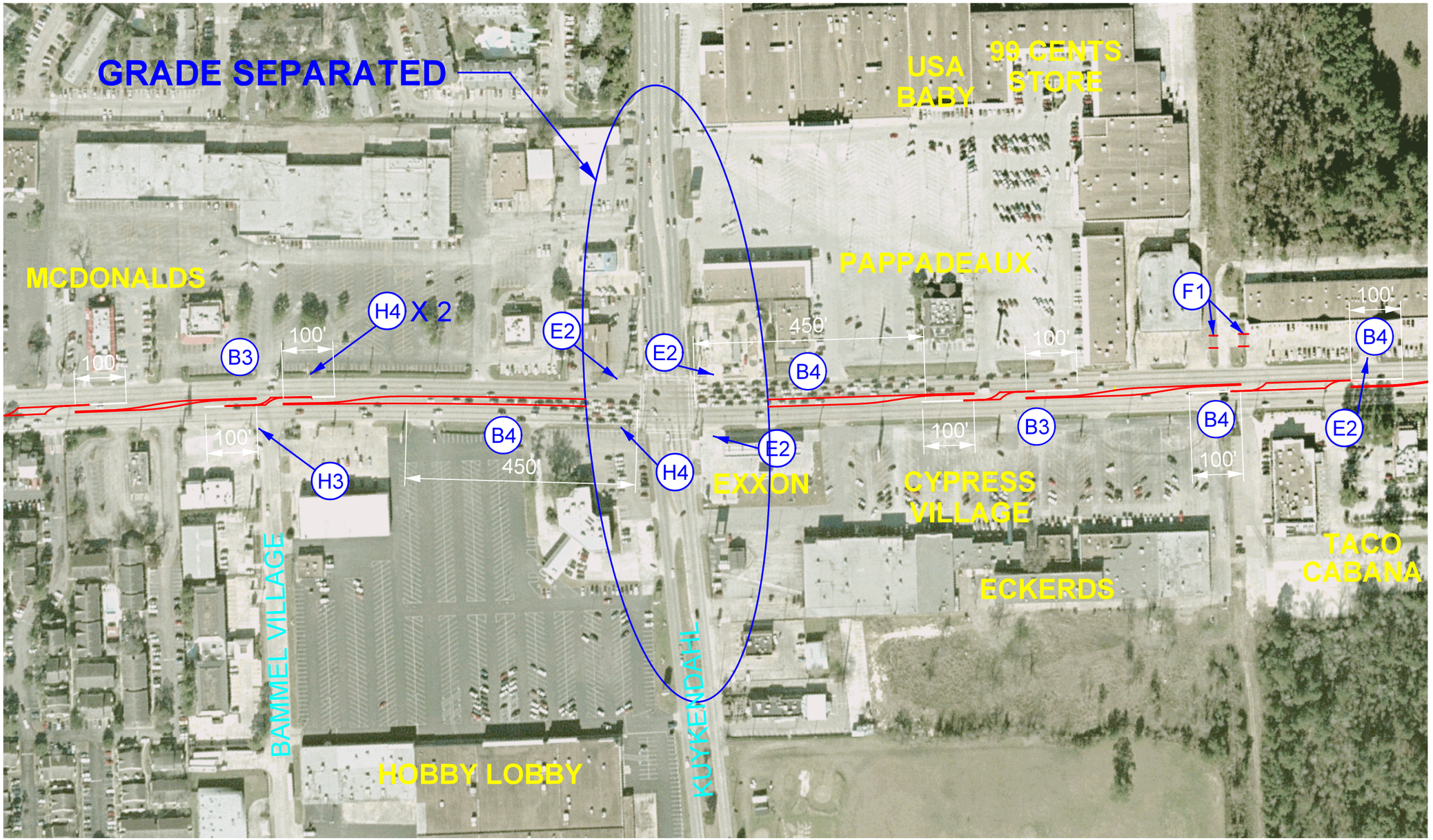

WUNDERLICH
TWEETERS
21ST CENTURY
H3
E2
B4
225'
200'
A3
175'
D3
E1
150'
100'
250'
WALGREENS
KLIEN BANK
SHOE WAREHOUSE
MCDONALDS
OLD NAVY
GREENWOOD
BRECK
TARGET
ROSS
CINEMA
TJ MAX

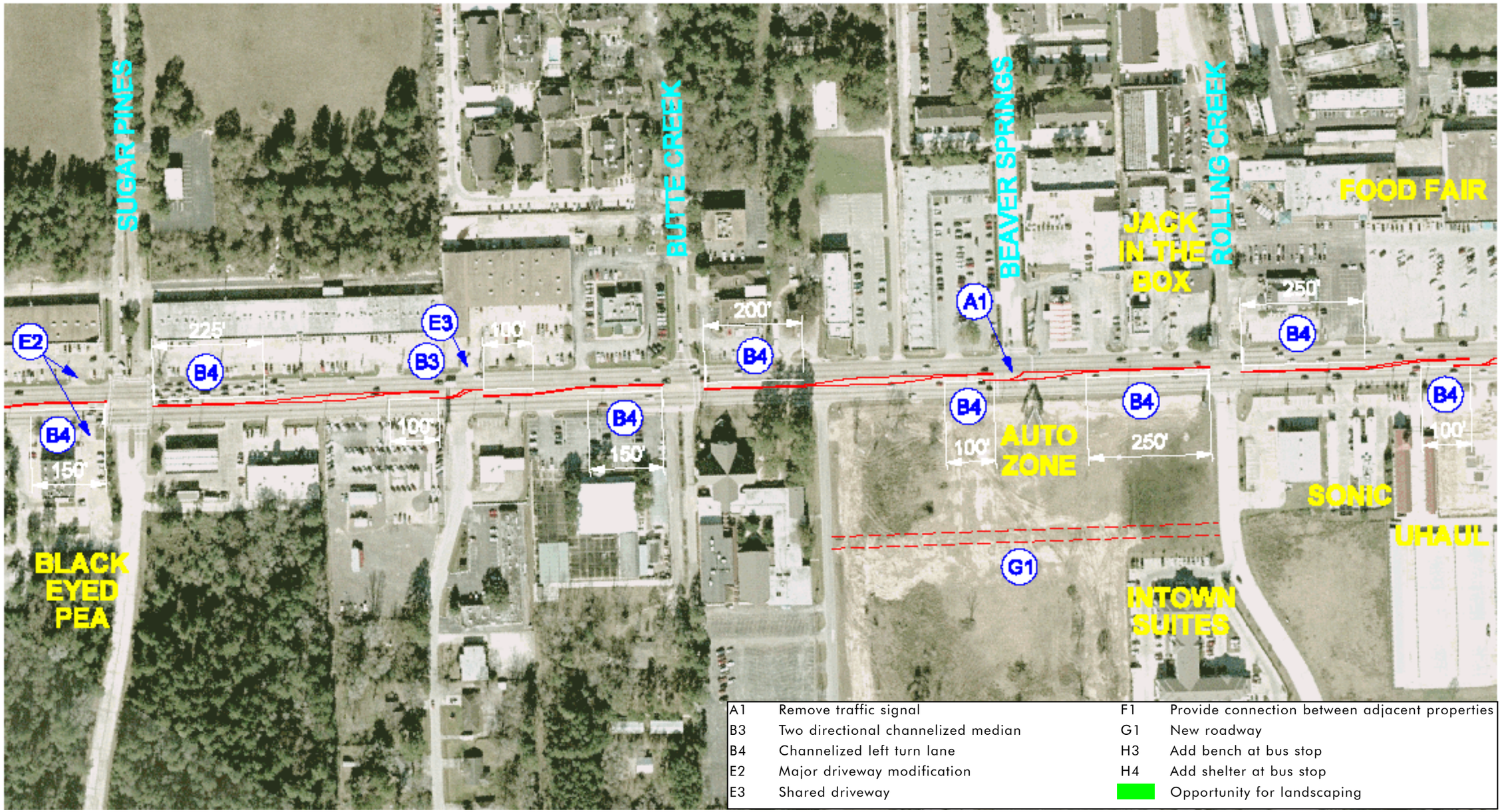

OFFICE DEPOT
STUEBNER-AIRLINE
BEST WESTERN
IN TOWN
TIMBER STONE APARTMENTS
CHASE
FOREST BRANCH
TORREY
VETERANS MEMORIAL
F1
E2
D4
345'
300'
C1
B4
B3
200'
100'
H3
H2
E1
150'
250'


GLADEBROOK
FALLING CREEK
PEBBLE BEND
WALTERS RD
E2
H3
B4
300'
200'
D3
100'
C7
150'
H2
HOLIDAY INN
B3 Two directional channelized median
B4 Channelized left turn lane
C1 Add right turn lane (FM 1960)
C7 Add sidewalks (FM 1960)
D3 Add right turn lane (cross streets)
D4 Extend existing turn bay (cross streets)
E1 Minor driveway modification
E2 Major driveway modification
F1 Provide connection between adjacent properties
H2 Provide sidewalk from bus stop to intersection
H3 Add bench at bus stop
Opportunity for landscaping

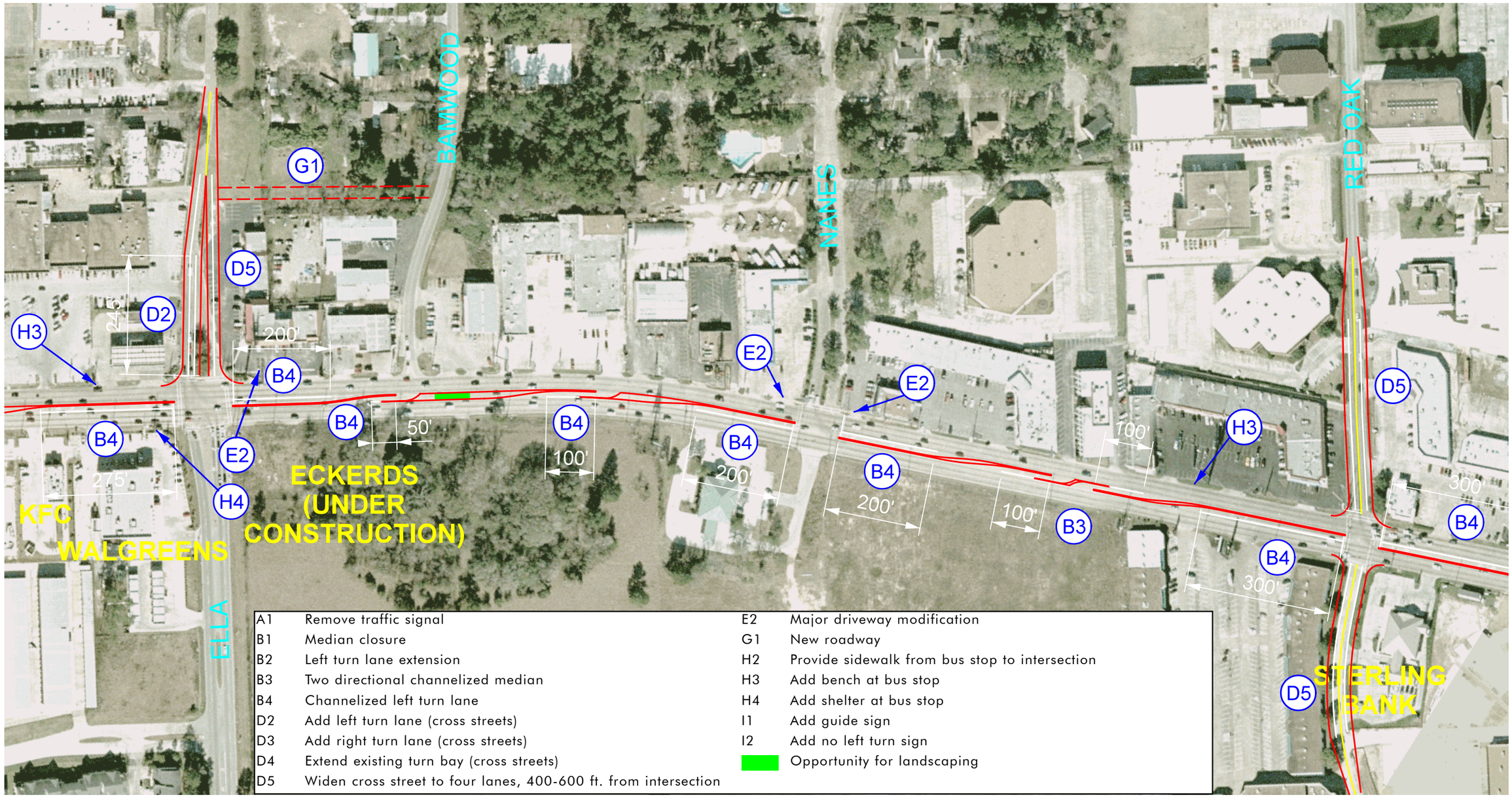

WALMART
T.C. JESTER
NORTHWOOD CHURCH
TERRACE OAKS
CVS PHARMACY
HUNAN CHEF
HARWIN CHAMPIONS
TUNE UP
MINTZ
DRAPER
100'
300'
250'
75'
B4
C7
D4
E2
A1
A2
H3
H4
F1


NORTHGATE FAIRWAY
NORTHGATE FOREST DR
FRITZ OAKS
FM 1960
100'
150'
B4
B3
A1
E2
F1
125'
DISCOUNT TIRE
WELCOME LN
AARONS
HOME & PATIO
A1 Remove traffic signal
A2 Modify traffic signal
B3 Two directional channelized median
B4 Channelized left turn lane
C7 Add sidewalks (FM 1960)
D4 Extend existing turn bay (cross streets)
E2 Major driveway modification
F1 Provide connection between adjacent properties
H3 Add bench at bus stop
H4 Add shelter at bus stop
Opportunity for landscaping


GRADE SEPARATED
MCDONALDS
USA BABY
99 CENTS STORE
PAPPADEAUX
EXXON
CYPRESS VILLAGE
ECKERDS
TACO CABANA
HOBBY LOBBY
BAMMEL VILLAGE
KUYKENDAHL
H4 X 2
B3
B4
E2
H3
H4
F1
100'
450'

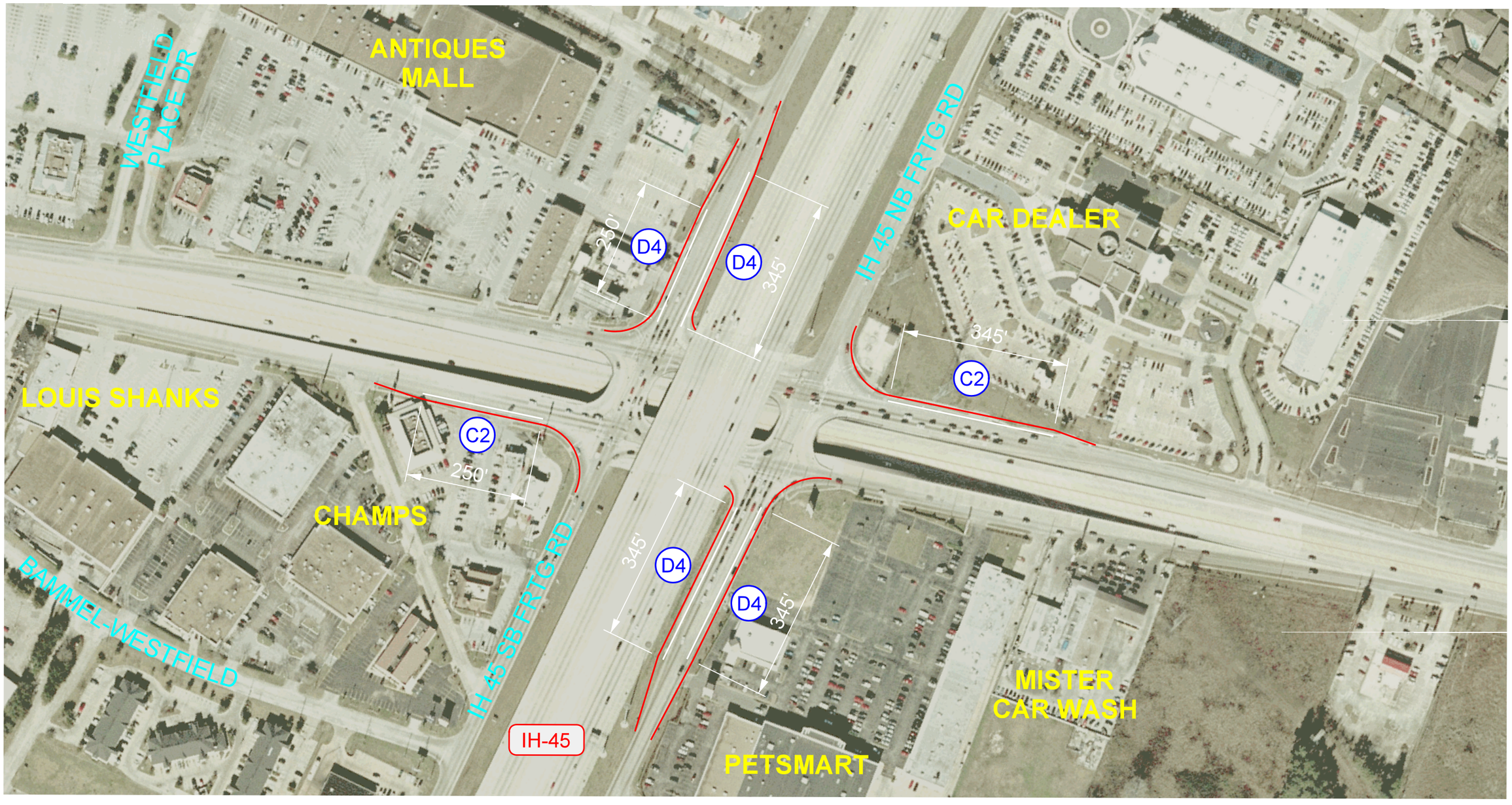


A1	Remove traffic signal	F1	Provide connection between adjacent properties
B3	Two directional channelized median	G1	New roadway
B4	Channelized left turn lane	H3	Add bench at bus stop
E2	Major driveway modification	H4	Add shelter at bus stop
E3	Shared driveway		Opportunity for landscaping

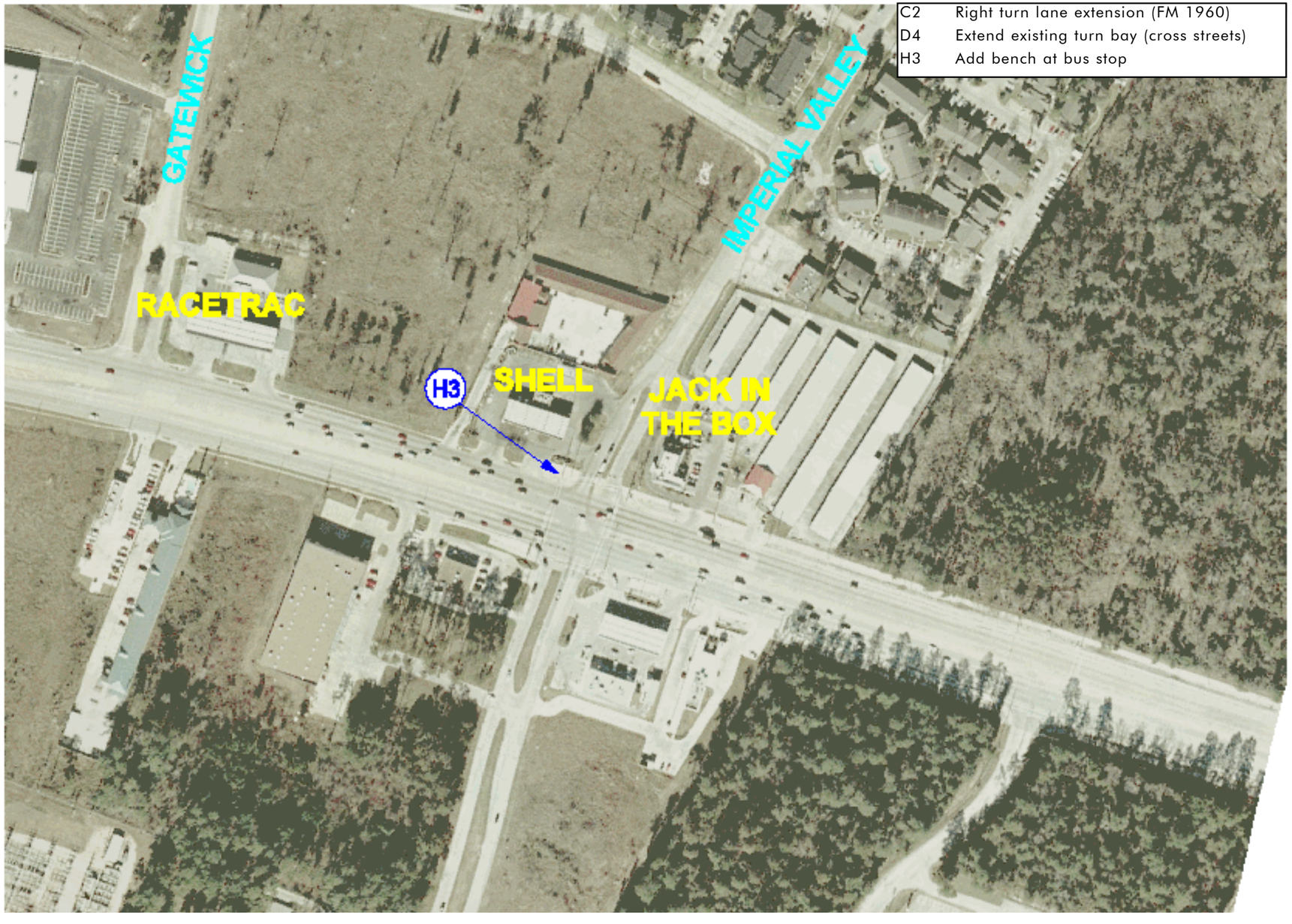


A1	Remove traffic signal	E2	Major driveway modification
B1	Median closure	G1	New roadway
B2	Left turn lane extension	H2	Provide sidewalk from bus stop to intersection
B3	Two directional channelized median	H3	Add bench at bus stop
B4	Channelized left turn lane	H4	Add shelter at bus stop
D2	Add left turn lane (cross streets)	I1	Add guide sign
D3	Add right turn lane (cross streets)	I2	Add no left turn sign
D4	Extend existing turn bay (cross streets)		Opportunity for landscaping
D5	Widen cross street to four lanes, 400-600 ft. from intersection		

Improvements


WESTFIELD PLACE DR
ANTIQUES MALL
IH 45 NB FRTG RD
CAR DEALER
LOUIS SHANKS
CHAMPS
BAMMEL-WESTFIELD
IH 45 SB FRTG RD
IH-45
PETSMART
MISTER CAR WASH
C2
250'
D4
345'

Improvements



C2	Right turn lane extension (FM 1960)
D4	Extend existing turn bay (cross streets)
H3	Add bench at bus stop

Due to the difficulty in describing the improvement locations, it is recommended that the aerial layout sheets be reviewed in conjunction with the improvement types list.

Projects were divided into short-, medium-, and long-range improvements based on the following criteria:

Short-Range Improvements

- Have relatively low construction cost
- Can be implemented within the right-of-way and/or requires minimal right-of-way
- Does not require extensive, if any, coordination with property owners
- Have short construction duration (1-2 years)

Medium-Range Improvements

- Have relatively low construction cost
- May require acquisition of right-of-way or may require work outside of the right-of-way
- May require utility adjustments
- May require coordination with other agencies and/or property owners
- Have moderate construction duration (2-4 years)

Long-Range Improvements

- Have high construction cost
- Will require additional right-of-way and/or work outside of the right-of-way
- Will require utility adjustments
- Will require coordination with other agencies and/or property owners
- Have long construction duration (5 years +)

For ease in summarizing the improvements, the corridor was divided into four segments:

Segment	Limits
1	Mills Rd to Cutten Rd
2	Cutten Rd to Stuebner-Airline Rd
3	Stuebner-Airline Rd to Kuykendahl Rd
4	Kuykendahl Rd to Imperial Valley

Table 5.1: corridor segments

Following the listing of improvements by range is a table summarizing the number of improvements by type within each segment.

SHORT-RANGE IMPROVEMENTS

General Corridor Improvements

- Add block numbers to street signs at all cross streets
- New pavement striping for entire length of corridor
- Signal synchronization for entire corridor
- Add back panel to E/W facing signals to reduce glare
- Add advanced sign information as needed
- Offer opportunities for landscaping by local entities
- Connect Harris County and TxDOT traffic communication systems to foster maximum roadway efficiency

Location Specific Improvements

Segment 1: Mills Road to Cutten Road

Recommended Median Improvements (TxDOT)

- Add dual left turn lanes at WB signalized entrance to Willowbrook Mall
- Close median west of Breton Ridge
- Extend the WB left turn lane at Breton Ridge
- Two directional channelized median between Willow Center Drive and Cutten Road
- Add channelized WB left turn lanes at:
  - Mills Road
  - East of Mills Road
  - Willow Center Drive
  - Between Willow Center Drive and Cutten Road
- Add channelized EB left turn lanes at:
  - Mills Road
  - Breton Ridge
  - Between railroad tracks and Willow Center Drive
  - Willow Center Drive
  - Cutten Road
- Convert EB through lane to a right turn lane into the signalized Willowbrook Mall entrance

Recommended Cross Street Improvements (Harris Co/TxDOT)

- Extend existing NB and SB left turn bays on Mills Road
- Extend existing NB right turn bay on SH 249 frontage road
- Add NB dual left turn lanes on Willow Center Drive
- Extend existing NB and SB left turn bays on Cutten Road

Recommended Signing Improvements (TxDOT)

- Add guide signs before Breton Ridge to inform WB drivers that next two signals can access Willowbrook Mall.

Recommended Driveway Modifications (Developers)

- Modify turn radius and increase throat length of driveway on the north side of the signalized mall entrance
- Add SB lane to driveway at signalized Willowbrook Mall Entrance, south of FM 1960

Recommended Bus Stop and Pedestrian Improvements (METRO)

- Add a bench to the bus stop located on the SW corner of the Cutten Road intersection

Segment 2: Cutten Road to Stuebner-Airline

Recommended Signal Improvements (TxDOT)

- Use a single signal controller for:
  - Champions Drive and Duncan Road signals
  - Greenwood Forest Drive and Wunderlich Drive signals

Recommended Median Improvements (TxDOT)

- Two directional, channelized median at:
  - East of Haynes Road
  - West of Shiloh Church Road
  - Between Paradise Valley Dr. and Champions Forest Dr.
- Add channelized, WB left turn lane at:
  - Cutten Road
  - Between Cutten Road and Champions Park Drive
  - Champions Drive
  - Duncan Road
  - Between Duncan Rd and Paradise Valley (three locations)
  - Paradise Valley Drive
  - Champions Forest Drive
  - Between Champions Forest Drive and Glen Erica Drive

- Glen Erica Drive
- Greenwood Forest Drive
- Wunderlich Drive
- Breck Road

- Add channelized EB left turn lane at:
  - Champions Park Drive
  - Champions Drive
  - West of Paradise Valley Drive
  - Paradise Valley Drive
  - Champions Forest Drive
  - Glen Erica Drive
  - Between Mighty Oaks Dr. and Greenwood Forest Dr.
  - Greenwood Forest Drive
  - Wunderlich Drive
  - Breck Road
  - East of Breck Road
  - West of Stuebner Airline (two locations)
  - Stuebner Airline

Recommended Cross Street Improvements (Harris Co./TxDOT)

- Widen Champions Road from two to four lanes, 400 to 600 feet north of FM 1960
- Extend existing SB right turn bay on Stuebner Airline

Recommended Driveway Modifications (Developers)

- Minor driveway modifications:
  - Between Cutten Road and Champions Park Dr. on south side of FM 1960
  - East of Duncan Road on south side of FM 1960
  - West of Champions Forest Dr. on south side of FM 1960
  - Between Champions Forest Dr. and Glen Erica Dr. on south side of FM 1960
  - West of Stuebner-Airline on north side of FM 1960
  - West of Stuebner-Airline on south side of FM 1960

Recommended Bus Stop and Pedestrian Improvements (METRO)

- Add bench at bus stops located:
  - West of Champions Park Dr. on the south side of FM 1960
  - SW corner of the Duncan Road intersection
  - SW corner of the Champions Forest Dr. intersection
  - NE and SW corners of the Greenwood Forest Drive intersection
  - SW corner of the Breck Road intersection

Segment 3: Stuebner-Airline to Kuykendahl

Recommended Signal Improvements (TxDOT)

- Remove traffic signals at:
  - Terrace Oaks Drive
  - Fritz Oaks Drive
- Modify traffic signal at T.C. Jester Boulevard to accommodate weekend church services

Recommended Median Improvements (TxDOT)

- Two directional channelized median at:
  - Forest Branch Boulevard
  - Fritz Oaks Drive
  - Between Fritz Oaks Drive and Bammel Village Drive
  - Bammel Village Drive
- Add channelized westbound left turn lane at:
  - Stuebner-Airline
  - Between Forest Branch Blvd. and Torrey Chase Blvd.
  - Torrey Chase Boulevard
  - Falling Creek Drive
  - Walters Road
  - Between Walters Road and T.C. Jester Boulevard
  - T.C. Jester Boulevard
  - Between T.C. Jester Blvd. and Terrace Oaks Drive
  - Mintz Lane

- Draper Road
- Welcome Lane
- Northgate Forest Drive

- Add channelized eastbound left turn lane at:
  - Torrey Chase Boulevard
  - Between Torrey Chase Blvd. and Gladebrook Drive
  - Gladebrook Drive
  - Falling Creek Drive
  - Walters Road
  - Between Walters Road and T.C. Jester Boulevard
  - T.C. Jester Boulevard
  - Terrace Oaks Drive
  - Northgate Fairway
  - Northgate Forest Drive
  - Kuykendahl Road

Recommended Cross Street Improvements (Harris Co./TxDOT)

- Extend existing NB right turn bay on Veterans Memorial
- Extend existing SB left turn bay on T.C. Jester Boulevard

Recommended Driveway Modifications (Developers)

- Minor driveway modification between Forest Branch Blvd. and Torrey Chase Blvd. on south side of FM 1960

Recommended Bus Stop & Pedestrian Improvements (METRO)

- Add bench at bus stops located at:
  - SW corner of Forest Branch Blvd. intersection
  - SW corner of Torrey Chase Blvd. intersection
  - NE corner of Falling Creek Drive intersection
  - SW and NE corners of Walters Road intersection
  - SW corner of Terrace Oaks Drive intersection
  - SW corner of Bammel Village Drive intersection
- Add shelter at bus stops located at:
  - Between Walters Road and T.C. Jester Blvd. on south side of FM 1960
  - NW corner of Bammel Village intersection (two shelters)
  - SW corner of Kuykendahl Road intersection

Segment 4: Kuykendahl Road to Imperial Valley Drive

Recommended Signal Improvements (TxDOT)

- Remove traffic signal at:
  - Beaver Springs Drive
  - Bammel Westfield Road

Recommended Median Improvements (TxDOT)

- Median closures at:
  - Between Hafer Road and Cypress Station Drive
  - Bammel Westfield Road
- Extend existing WB left turn bay at Hafer Road
- Extend existing WB and EB left turn bays at Cypress Station
- Two directional channelized median at:
  - Between Kuykendahl Road and Sugar Pine Drive
  - Silver Ridge Drive
  - Between Nanes Road and Red Oak Drive
- Add channelized westbound left turn lane at:
  - Kuykendahl Road
  - Between Kuykendahl Road and Sugar Pine Drive
  - Sugar Pine Drive
  - Butte Creek Road
  - Rolling Creek Drive
  - Ella Boulevard
  - Nanes Road
  - Red Oak Drive
- Add channelized eastbound left turn lane at:
  - Between Kuykendahl Road and Sugar Pine Drive
  - Sugar Pine Drive
  - Butte Creek Road
  - Beaver Springs Drive
  - Rolling Creek Drive
  - Between Rolling Creek Drive and Ella Boulevard
  - Ella Boulevard

- Bamwood Drive
- Between Bamwood Drive and Nanes Road
- Nanes Road
- Red Oak Drive
- East of Red Oak Drive
- St. Edwards
- Hafer Road
- Between Hafer Road and Cypress Station Drive

Recommended Cross Street Improvements

(Harris Co./TxDOT)

- Add SB left-turn lane on Ella Boulevard
- Extend existing NB left-turn bay on Cypress Station Drive north of FM 1960
- Extend existing SB left-turn bay on Cypress Station Drive
- Extend existing right and left-turn bays on IH 45 NB and SB frontage roads
- Widen Hafer Road from two to four lanes, 400 to 600 feet south of FM 1960

Recommended Signing Improvements (TxDOT)

- Add guide signs for Cypress Station Drive
- Add no left turn sign at Bammel Westfield Road

Recommended Bus Stop and Pedestrian Improvements

(METRO)

- Add bench at bus stops located at:
  - NW of Ella Boulevard intersection
  - NW of Red Oak Drive intersection
  - NE of Cypress Station Drive intersection
  - NW corner of Imperial Valley Drive intersection
- Add shelter at bus stops located at:
  - SW corner of Ella Boulevard intersection

		SHORT RANGE									
		Improvements Along FM 1960 by TxDOT									
		A.1	A.2	A.3	B.1	B.2	B.3, B.4, C.3	C.5	I.1	I.2	
Segment		Remove Traffic Signal	Modify Traffic Signal	Use Single Signal Controller	Median Closure	Left Turn Lane Extension	Raised Medians (Two Directional Channelized Median, Channelized Left Turn Lane, Add Dual Lefts) (percentage)*	Convert Through Lane to Turn Lane	Add Guide Signs	Add No Left Turn Sign	Signal Synchronization/ EMS Devices/ Overhead Street Name Signs/ Signal Back Plates/ Communications Coordination
1	Mills to Cutten	0	0	0	1	1	10%	1	1	0	6
2	Cutten to Stuebner-Airline	0	0	2	0	0	34%	0	0	0	9
3	Stuebner Airline to Kuykendahl	2	1	0	0	0	36%	0	0	0	9
4	Kuykendahl to Imperial Valley	2	0	0	3	3	20%	0	1	1	12
Total	**Mills to Imperial Valley**	**4**	**1**	**2**	**4**	**4**	**100%**	**1**	**2**	**1**	**36**

Table 5.2 - Short-range improvements by TxDOT

* Percentage of total improvement cost within identified limits
Note: Refer to Section 7 for cost of improvements.

		SHORT RANGE						
		Improvements on Cross Streets by Harris County / TxDOT				Improvements to Properties By Developers	Improvements to Bus Stop Locations by METRO	
		D.1	D.2	D.4	D.5	E.1 & E.2	H.3	H.4
Segment		Add Dual Lefts	Add Left-Turn Lane	Extend Existing Turn Bay	Widen to 4 Lanes 400' - 600' from FM 1960	Driveway Modifications	Add Bench at Bus Stop Location	Add Shelter at Bus Stop Location
1	Mills to Cutten	1	0	5	0	3	1	0
2	Cutten to Stuebner-Airline	0	0	1	1	6	6	0
3	Stuebner Airline to Kuykendahl	0	0	2	0	1	7	4
4	Kuykendahl to Imperial Valley	0	1	6	1	0	4	1
Total	**Mills to Imperial Valley**	**1**	**1**	**14**	**2**	**10***	**18**	**5**

Table 5.3 - Short-range improvements by others

* 9 Minor Driveway Modifications and 1 Major Driveway Modification

Note: Refer to Section 7 for cost of improvements.

MEDIUM-RANGE IMPROVEMENTS

Segment 1: Mills Road to Cutten Road

Recommended Median Improvements (TxDOT)

- Add WB right turn lane at Mills Road

Recommended Cross Street Improvements (Harris Co./TxDOT)

- Add NB and SB right turn lanes on Mills Road

Recommended Roadway Widening (City of Houston)

- Widen Mills Road from two to four lanes, 400 to 600 feet north of FM 1960
- Widen Mills Road from two to four lanes from FM 1960 to W. Greens Road

Recommended Driveway Modifications (Developers)

- Major driveway modifications:
  - West of Willow Center Drive on south side of FM 1960
  - Align driveway on north side of FM 1960 near Willow Center Drive with intersection
- Connect adjacent properties in the vicinity:
  - Between railroad tracks and Willow Center Drive on north side of FM 1960
  - Champions Center Drive on north side of FM 1960
  - Between Willow Center Drive and Cutten Road on south side of FM 1960 (two locations)

Segment 2: Cutten Road to Stuebner-Airline

Recommended Median Improvements (TxDOT)

- Add EB right turn lane at Stuebner Airline

Recommended Cross Street Improvements (Harris Co./TxDOT)

- Widen Duncan Road from two to four lanes, 400 to 600 feet south of FM 1960
- Add SB and NB dual left turn lanes on Champion Forest
- Add NB right turn lane on Greenwood Forest Drive

Recommended Driveway Modifications (Developers)

- Major driveway modifications:
  - East of Cutten Road on south side of FM 1960
  - Between Cutten Road and Champions Park Drive on south side of FM 1960
  - South of Champions Park Drive intersection
  - Between Haynes Road and Shiloh Church Road on north side of FM 1960
  - West of Shiloh Church Road on north side of FM 1960
  - West & east of Paradise Valley Dr. on north side of FM 1960
  - West of Champions Forest Dr. on south side of FM 1960
  - East of Champions Forest Dr. on north side of FM 1960
  - Between Mighty Oaks Drive and Greenwood Forest Boulevard on south side of FM 1960 (two driveways)
  - West of Breck on south side of FM 1960 (two driveways)
  - West of Stuebner Airline on north side of FM 1960
- Connect adjacent properties:
  - Between Haynes Road and Shiloh Church Road on north side of FM 1960
  - Between Shiloh Church Road and Duncan Road on south side of FM 1960 (two locations)
  - Between Duncan Road and Paradise Valley Drive on south side of FM 1960 (three locations)
  - East of Paradise Valley Drive on north side of FM 1960
  - Between Champions Forest Drive and Glen Erica Road on north side of FM 1960 (two locations)

Recommended Bus Stop and Pedestrian Improvements (METRO)

- Add sidewalk from bus stop to Stuebner Airline intersection on south side of FM 1960
- Add sidewalk from bus stop to FM 1960 on west side of Stuebner Airline

Segment 3: Stuebner-Airline to Kuykendahl

Recommended Median Improvements (TxDOT)

- Add WB right turn lane at Stuebner Airline

Recommended Cross Street Improvements (Harris Co./TxDOT)

- Add NB and SB right turn lanes on Walters Road

Recommended Driveway Modifications (Developers)

- Major driveway modifications:
  - East of Stuebner Airline, north side of FM 1960
  - West of Gladebrook Drive on north side FM 1960
  - Southeast corner of Walters Road intersection (two locations)
  - Between Walters Road and T.C. Jester Blvd. on north side of FM 1960
  - West of T.C. Jester Blvd. on south side of FM 1960
  - East of Fritz Oaks on north side of FM 1960
  - West of Kuykendahl Road on north side of FM 1960
- Connect adjacent properties:
  - Between Forest Branch Boulevard and Stuebner Airline on north side of FM 1960
  - Between Walters Road and T.C. Jester Boulevard on south side of FM 1960
  - Between T.C. Jester Boulevard and Terrace Oaks Drive on south side of FM 1960
  - Between Fritz Oaks and Bammel Village Drive on south side of FM 1960

Recommended Bus Stop and Pedestrian Improvements

- Add sidewalks between Walters Road and T.C. Jester Blvd. on the north side of FM 1960 (two locations) (TxDOT)
- Add sidewalk from bus stop to Walters Road north of FM 1960 (METRO)

Segment 4: Kuykendahl to Imperial Valley

Recommended Median Improvements (TxDOT)

- Extend existing right-turn bays on FM 1960 EB and WB at IH 45 Frontage Roads

Recommended Cross Street Improvements (Harris Co./TxDOT)

- Widen Ella Boulevard from two to four lanes, 400 to 600 feet north of FM 1960
- Widen Red Oak Drive from two to four lanes, 400 to 600 feet north and south of FM 1960
- Widen Cali Drive from two to four lanes, 400 to 600 feet north of FM 1960
- Add SB right-turn lane on Cypress Station

Recommended Driveway Modifications (Developers)

- Major driveway modifications:
  - East of Kuykendahl on north and south sides of FM 1960
  - Between Kuykendahl Road and Sugar Pine Drive on north side of FM 1960
  - West of Sugar Pine Drive on north side and south side of FM 1960 (two locations)
  - East of Ella Boulevard on north side of FM 1960
  - East and west sides of Nanes Road on north side of FM 1960 (two locations)
  - West of Hafer Road on south side of FM 1960
  - East of Cypress Station Drive on north side (one location) and south side (two locations) of FM 1960
- Shared driveway north side of Silver Ridge intersection
- Connect adjacent properties:
  - Between Kuykendahl Road and Sugar Pine Drive on north side of FM 1960 (two locations)

Recommended Bus Stop and Pedestrian Improvement (METRO)

- Add sidewalks from bus stop just east of Cali Drive to Cali Drive on the north side of FM 1960

		MEDIUM RANGE										
		Improvements Along FM 1960 by TxDOT			Improvements on Cross Streets by Harris County / TxDOT			City of Houston	Improvements to Properties by Developers			Improvements to Bus Stop Locations by METRO
		C.1	C.2	C.7	D.1	D.3	D.5	D.5	E.2	E.3	F.1	H.2
Segment		Add Right Turn Lane	Right Turn Lane Extension	Add Sidewalks	Add Dual Lefts	Add Right-Turn Lane	Widen to 4 Lanes (Cross Streets)	Widen to 4 Lanes (Cross Streets) (miles)	Major Driveway Modifications	Shared Driveway	Connect Adjacent Properties	Add Sidewalks from Bus Stop to Intersection
1	Mills to Cutten	1	0	0	0	2	0	1.0	2	0	5	0
2	Cutten to Stuebner Airline	1	0	0	2	1	1	0	14	0	9	2
3	Stuebner-Airline to Kuykendahl	1	0	2	0	2	0	0	8	0	4	1
4	Kuykendahl to Imperial Valley	0	2	0	0	1	4	0	12	1	1	1
Total	**Mills to Imperial Valley**	**3**	**2**	**2**	**2**	**6**	**5**	**1.0**	**36**	**1**	**19**	**4**

Table 5.4 - Medium-range improvements

Note: Refer to Section 7 for cost of improvements.

LONG-RANGE IMPROVEMENTS

Segment 1: Mills Road to Cutten Road

Recommended New Roadways (Harris County)

- New parallel roadway on north side of FM 1960 from Cutten Road to Champions Centre Drive

Recommended Grade Separations (TxDOT)

- Grade separate FM 1960 at RR Tracks

Segment 2: Cutten Road to Stuebner-Airline

Recommended New Roadways (Harris County)

- New parallel roadway on south side of FM 1960 from Shiloh Church Road to Duncan Road

Recommended Grade Separations (TxDOT/Harris County)

- Grade separate Stuebner-Airline and FM 1960

Segment 3: Stuebner-Airline to Kuykendahl

No Recommended Long-Range Improvements

Segment 4: Kuykendahl to Imperial Valley

Recommended New Roadways (Developer)

- New parallel roadway on south side of FM 1960 from Mathis Church Road to Rolling Creek Drive
- New parallel roadway on south side of FM 1960 from Ella Boulevard to Hafer Road

Recommended New Roadways (Harris County)

- New parallel roadway on south side of FM 1960 from Cypress Station Drive to Bammel Westfield Road

		LONG RANGE		
		Improvements on Cross Streets by Harris County	**TxDOT / Harris County**	**Improvements to Properties by Developers**
		G		G
Segment		New Roadway (miles)	Grade Separation	New Roadway (miles)
1	Mills to Cutten	0.17	1	0.00
2	Cutten to Stuebner-Airline	0	1	0.26
3	Stuebner Airline to Kuykendahl	0	0	0.00
4	Kuykendahl to Imperial Valley	0.28	0	0.86
Total	**Mills to Imperial Valley**	**0.45**	**2**	**1.12**

Table 5.5 - Long-range improvements

Note: Refer to Section 7 for cost of improvements.

SECTION 6

TRAFFIC ANALYSIS

In order to evaluate the benefits of the access management improvement concepts recommended for the FM 1960 corridor, a traffic analysis was performed. The traffic analysis process included evaluation of both the existing traffic conditions and projected conditions after implementation of the recommended improvements, comparing key traffic operational performance indicators. This section describes the evaluation methodology, data collection, traffic simulation analysis, the measures of effectiveness used to evaluate operational performance, and development and calibration of the existing traffic model. In addition, the recommended improvements added to the existing traffic model are described, as well as their projected impacts and benefits to the FM 1960 corridor.

EVALUATION METHODOLOGY

- Collect data to develop existing conditions traffic operations model
- Develop, calibrate and validate existing conditions traffic model using VISSIM
- Incorporate recommended improvements into traffic model
- Compare projected traffic operations of improved vs. existing conditions

Data Collection

Several types of traffic data input were necessary for development of the traffic model. Existing roadway geometric and lane utilization data were collected for the study area. PM peak hour turning movement traffic volume counts were conducted at model study area intersections and selected driveways in November 2003. Average travel time data was collected using the floating car technique. Delay and queue studies also were conducted at selected intersections. Travel time, delay and queue data were collected in March 2004. Traffic signal timing information was obtained from the City of Houston and TxDOT, and METRO provided transit ridership data for the FM 1960 corridor. TxDOT provided crash data for the three-year period from 1999 to 2001; H-GAC provided detailed crash data for the period 1998 to 2000.

Traffic Simulation Analysis

Using VISSIM (version 3.7), traffic simulation models were developed for three representative sections of the FM 1960 corridor: Mills Road to Cutten Road (West Section); Walters Road to Kuykendahl Road (Middle Section); and, Red Oak Drive to Imperial Valley Drive (East Section). VISSIM is a microscopic, time step and behavior based model developed to model urban and public transit operations. For each section modeled, VISSIM provides estimates of average travel time (seconds), average delay (seconds), and number of stops (stops per vehicle), in addition to numerous other measures of effectiveness. Due to high weekend traffic volumes, particularly in the vicinity of Willowbrook Mall, a weekend peak hour model was developed for the West Section in addition to the three weekday PM peak hour models.

Measures of Effectiveness

The operational performance for different traffic conditions are evaluated in terms of measures of effectiveness (MOEs) such as travel time, number of stops, delay, queues, and vehicle hours of travel (VHT). These MOEs provide a basis for evaluating network performance with the proposed improvements compared to network performance under existing conditions. The MOEs are defined on the next page.

Travel Time: This represents the average travel time, in seconds, for vehicles to traverse the section modeled, under the given roadway geometric, traffic volume and traffic control conditions.

Average Delay: This represents the difference in seconds between ideal travel time for the section and the actual travel time under the given roadway geometric, traffic volume and traffic control conditions.

Stops: This represents the total number of vehicular stops in the section modeled, aggregated for all vehicles during the peak hour.

Queue: This represents the length of a line of vehicles waiting to resume travel along FM 1960 after a delay due to a traffic control device such as a signal.

Vehicle Hours Traveled (VHT): This represents the total amount of time spent by drivers traveling along the section modeled, aggregated for all vehicles during the peak hour.

Existing Traffic Model Development

Within the three sections modeled, FM 1960 is primarily a seven-lane roadway with three lanes each in both the west and eastbound directions plus a continuous left turn lane. There are two exceptions: the West Section between SH 249 and Breton Ridge and the East Section between Cali Drive/Hafer Road and IH 45, have raised median. The primary land use in all three sections is commercial. Each of the three sections includes six signalized intersections as shown in Table 6.1.

FM 1960 Signalized Intersections		
West Section	**Middle Section**	**East Section**
Mills Road	Walters Road	Red Oak Drive
SH 249 (four intersections)	TC Jester Boulevard	Cali Drive/Hafer Road
Willowbrook Mall Entrance	Terrace Oaks Drive	Cypress Station Drive
Breton Ridge	Northgate Forest Drive	Bammel Westfield Road
Willow Centre Drive	Fritz Oaks Place	IH 45 (four intersections)
Cutten Road	Kuykendahl Road	Imperial Valley Drive

Table 6.1: Signalized intersections within each section

Calibration/Validation

The traffic simulation models for existing PM peak hour conditions were calibrated and validated to ensure the resulting output properly duplicated existing traffic operating conditions. Default model input parameters, such as driver performance, were modified to achieve results within acceptable limits. Measures used in the calibration/validation process included average travel time, average vehicle delay and queue length. Model output for these measures of effectiveness were compared with field data and modifications to the traffic model were made to match the two sets of data. Average travel time data helped to calibrate/validate the modeled sections as a whole, while delay and queue data helped calibrate/validate intersections within the modeled sections. For example, the simulated travel time and field-measured travel time were compared to determine if they were similar enough to be considered acceptable. This travel time threshold accounts for variations in traffic distribution, such as driver and automobile population, yellow reaction time, gap acceptance factor, courtesy deceleration rate, and other contributing factors. Travel time data obtained using the floating car travel time technique is based on the experiences of a single driver on individual trips during the PM peak hour.

Field reviews showed that traffic conditions along FM 1960 tend to fluctuate from day to day, depending on traffic conditions on other roads that feed FM 1960. To account for these factors, a travel time acceptable threshold, or travel time tolerance, of 35 seconds was considered acceptable for calibration purposes. Calibration results are shown in Table 6.2.

FM 1960 Analysis Section	Travel Direction	Distance (Miles)	Floating Car Travel Time (seconds)	Simulation Travel Time (seconds)	Difference (seconds)
Mills Road to Cutten Road (Weekday PM peak hour)	EB	1.52	304	338	34
	WB		270	299	29
Mills Road to Cutten Road (Weekend peak hour)	EB	1.52	374	340	34
	WB		268	271	3
Walters Road to Kuykendahl Road (Weekday PM peak hour)	EB	1.50	229	241	12
	WB		225	229	4
Red Oak Drive to Imperial Valley Drive (Weekday PM peak hour)	EB	1.48	354	361	7
	WB		363	355	8

Table 6.2: Existing Model Calibration for PM Peak Period Travel Time

Recommended Improvements Traffic Model

While the medium range improvements may require more time for coordination and design, both the short and medium range improvements were included in the traffic model and are recommended for implementation as soon as possible. In most cases all of these improvements can be constructed independently. The short- and medium-range improvements included in the model are listed in Table 6.3.

Short Range	Medium Range
Raised Medians	Right Turn Bays
Left Turn Bays	Right Turn Bay Extensions
Left Turn Bay Extensions	Widen Cross Street to 4 lanes
Median Closures	Major Driveway Modifications
Minor Driveway Modifications	
Traffic Signal Removals	
Traffic Signal Modifications	
Traffic Signal Synchronization	

Table 6.3: Recommended improvements included in traffic model

Improvement Analysis Results

The impact on traffic operations was evaluated for each section based on implementation of all recommended improvements as a whole. Where necessary, traffic was re-routed to account for geometric changes. For example, in implementing the raised median, existing traffic executing mid-block left-turn maneuvers (where no openings were proposed) was re-routed to the downstream intersection or median opening. The analysis scenarios for the recommended improvement are:

Existing: This is the base scenario used in assessing the benefits of recommended improvements. This scenario replicates existing field conditions including signal phasing and intervals, lane configuration and assignment, traffic volumes, and vehicle speeds.

Proposed: This scenario provides a projection of traffic operations assuming implementation of the recommended short- and medium-range improvements.

West Section - Mills Road to Cutten Road

Traffic operations for the West Section of the study corridor are summarized in Tables 6.4 and 6.5. The improvements are projected to reduce travel time by 12% in both directions, reduce delay by up to 28%, and reduce the number of stops by up to 31% during the weekday PM peak hour. During the weekend peak hour, the proposed improvements are projected to reduce travel time by up to 14%, reduce delay by up to 43%, and reduce the number of stops by up to 41%.

Mills Road to Cutten Road							
Scenario	Direction	Travel Time (seconds)	Percent Improvement	Average Delay (seconds)	Percent Improvement	Stops (number)	Percent Improvement
Existing	EB	338	-	169	-	4834	-
	WB	299	-	129	-	4088	-
Proposed	EB	298	**12%**	130	**23%**	3877	**20%**
	WB	263	**12%**	93	**28%**	2828	**31%**

Table 6.4: Measures of effectiveness - Weekday PM Peak Hour

Mills Road to Cutten Road							
Scenario	Direction	Travel Time (seconds)	Percent Improvement	Average Delay (seconds)	Percent Improvement	Stops (number)	Percent Improvement
Existing	EB	339	-	217	-	6202	-
	WB	270	-	146	-	3202	-
Proposed	EB	292	**14%**	123	**43%**	3637	**41%**
	WB	260	**4%**	90	**38%**	2239	**30%**

Table 6.5: Measures of effectiveness - Weekend Peak Hour

Middle Section - Walters Road to Kuykendahl Road

Traffic operations for the Middle Section of the study corridor are summarized in Table 6.6. The improvements are projected to reduce travel time by up to 17%, reduce delay by up to 57%, and reduce the number of stops by up to 62% during the weekday PM peak hour.

East Section - Red Oak Drive to Imperial Valley Drive

Traffic operations for the East Section of the study corridor are summarized in Table 6.7. The improvements are projected to reduce travel time by up to 23%, reduce delay by up to 42%, and reduce the number of stops by up to 61% during the weekday PM peak hour.

Walters Road to Kuykendahl Drive							
Scenario	**Direction**	**Travel Time (seconds)**	**Percent Improvement**	**Average Delay (seconds)**	**Percent Improvement**	**Stops (number)**	**Percent Improvement**
Existing	**EB**	241	-	71	-	2127	-
	WB	229	-	60	-	2550	-
Proposed	**EB**	200	**17%**	30	**57%**	1167	**45%**
	WB	198	**13%**	29	**51%**	971	**62%**

Table 6.6: Measures of Effectiveness - Weekday Peak Hour

Red Oak Road to Imperial Valley Drive							
Scenario	**Direction**	**Travel Time (seconds)**	**Percent Improvement**	**Average Delay (seconds)**	**Percent Improvement**	**Stops (number)**	**Percent Improvement**
Existing	**EB**	361	-	182	-	4784	-
	WB	355	-	175	-	5570	-
Proposed	**EB**	277	**23%**	106	**42%**	2452	**49%**
	WB	281	**21%**	111	**37%**	2169	**61%**

Table 6.7: Measures of Effectiveness - Weekday PM Peak Hour

Vehicle Hours Traveled (VHT)

Table 6.8 summarizes vehicle hours traveled (VHT) along FM 1960 for the three modeled sections. The improvements are projected to reduce VHT in the West Section by 23 percent during the weekday PM peak hour and by 27 percent during the weekend peak hour. VHT also is projected to improve by 9 percent in the Middle Section and by 39 percent in the East Section. The recommended improvements are expected to reduce VHT for the entire corridor, during the weekday PM peak hour, by approximately 25 percent.

	West Section (Weekday PM)	**West Section (Weekend Peak)**	**Middle Section (Weekday PM)**	**East Section (Weekday PM)**
Existing	216	221	196	245
Proposed	165	161	178	149
Percent Improvement	**-23%**	**-27%**	**-9%**	**-39%**

Table 6.8: Vehicles Hours Traveled (VHT)

Queues

Table 6.9 summarizes average and maximum vehicle queues for intersections along FM 1960. The maximum westbound approach queue at the Willowbrook Mall Entrance during the weekday PM peak hour is approximately 1,280 feet under existing conditions but would be reduced to 461 feet with the recommended improvements. The maximum queue on the eastbound approach at Breton Ridge is projected to improve from 1,429 feet to 407 feet during the weekend peak hour.

QUEUES	Average Queue (feet)			Maximum Queue (feet)		
	Existing	Proposed	% change	Existing	Proposed	% change
Weekday PM Peak Hour						
Mall Entrance						
Eastbound Approach	114	75	-34%	515	395	-23%
Westbound Approach	239	92	-62%	1280	461	-64%
Breton Ridge						
Eastbound Approach	196	10	-95%	880	125	-86%
Westbound Approach	116	19	-84%	869	522	-40%
Kuykendahl						
Eastbound Approach	250	80	-68%	847	498	-41%
Westbound Approach	1344	171	-87%	1676	695	-59%
TC Jester						
Eastbound Approach	13	37	185%	261	179	-31%
Westbound Approach	24	50	108%	344	262	-24%
Red Oak						
Eastbound Approach	121	76	-37%	692	445	-36%
Westbound Approach	196	135	-31%	724	603	-17%
Cali						
Eastbound Approach	412	52	-87%	1,240	324	-74%
Westbound Approach	166	34	-80%	832	252	-70%
Weekend Peak Hour						
Mall Entrance						
Eastbound Approach	400	217	-46%	1296	728	-44%
Westbound Approach	100	81	-19%	405	374	-8%
Breton Ridge						
Eastbound Approach	395	65	-84%	1429	407	-72%
Westbound Approach	147	112	-24%	562	554	-1%

Table 6.9: Average and Maximum Approach Queues

Travel Time Savings

Travel time savings are created by increasing the speed of travel and by reducing the delay effects of traffic congestion. To evaluate travel time savings, a monetary value is placed on the amount of time saved. According to the Texas Transportation Institute (1997) the value of time based on congestion is $12.87 per person-hour. Using the Consumer Price Index to adjust for inflation, and assuming average vehicle occupancy of 1.2 persons, the value of time per vehicle is equivalent to $18.25 per hour. Based on the traffic simulation models developed for selected sections of the FM 1960 corridor, the recommended improvements would result in approximately 165 hours in VHT savings during the weekday PM peak hour. Projecting these savings for the limits of the three traffic models to the entire FM 1960 study area corridor yields approximately 260 hours in VHT savings. Assuming 260 weekdays in a year, the annual PM peak hour travel time savings due to the recommended improvements are estimated at $1.2 million.

Crash Cost Savings

The recommended FM 1960 corridor improvements, such as the raised median and driveway improvements, will reduce crash risk by reducing conflict points and providing more efficient traffic operation. Crash savings are based on average crash rates, which vary by class and type of facility. Subsequently, divided and undivided roadway facilities have different crash rates. According to the NCHRP publication "Impacts of Access Management Techniques", suburban facilities with raised medians have 16 percent lower crash rates than roadways with continuous left-turn lanes.

To illustrate the impact of reducing accidents, the monetary costs per crash type (fatal, serious injury, other injury and property damage) were used, as reported by the National Safety Council, shown in Table 6.10. Using these monetary values, the three year FM 1960 corridor crash history for 1998-2000, and the estimated 16 percent reduction in crashes due to the presence of raised medians, the average annual crash savings resulting from the recommended FM 1960 corridor improvements were estimated at $10 million.

[1] Based upon "Estimating the Cost of Unintentional Injuries," National Safety Council, 2003, adjusted to 2004 dollars

Crash Type	Cost
Per Fatality	$3,722,000
Per Serious Injury Accident	$234,000
Per Other Injury Accident	$23,000
Per Property Damage Accident	$2,000

Table 6.10: Crash Costs by Severity

Air Quality

The term "emissions" generally refers to gases and particles introduced into the air. The United States Environmental Protection Agency (EPA) describes air pollution as the contamination of air by the discharge of harmful substances. These harmful substances include hydrocarbons (HC), carbon monoxide (CO) and nitrogen oxides (NOx). Ozone is not directly emitted, but is rather formed from other emissions including HC and CO. The concentration of these air pollutants is related to traffic congestion. Lower speeds associated with traffic congestion tend to result in higher levels of pollutants.

The recommended improvements for FM 1960 are designed to improve safety and reduce delay along the corridor. Based on modeling results, the increase in travel speed resulting from implementation of these recommendations is estimated to result in a four percent reduction in HC and CO levels, and a three percent reduction in NOx levels.

ACCESS MANAGEMENT BENEFITS ON FM 1960

- Annual Travel Time Savings $1.2 million
- Annual Crash Cost Savings $10 million

SECTION 7

IMPLEMENTATION OF RECOMMENDED IMPROVEMENTS

	Primary Funding Source	TxDOT			Harris County			City of Houston			METRO			Private Developers			TOTALS (in Millions)
	Secondary Funding Source				TxDOT			TxDOT			Other Agencies			Other Government Agencies			
	Item	Number	Unit Cost	Cost	Number	Unit Cost	Cost	Number	Unit Cost	Cost	Number	Unit Cost	Cost	Number	Unit Cost	Cost	
Short Range	Remove Traffic Signal	4	$ 20,200	$ 80,800													
	Modify Traffic Signal	1	$ 3,800	$ 3,800													
	Use Single Signal Controller	2	$ 25,000	$ 50,000													
	Median Closure	4	$ 21,200	$ 84,800													
	Left Turn Lane Extension	4	$ 32,400	$ 129,600													
	Raised Medians			$ 3,328,000													
	Convert Through Lane to Turn Lane	1	$ 8,000	$ 8,000													
	Add Guide Signs	2	$ 1,700	$ 3,400													
	Add No Left Turn Sign	1	$ 1,800	$ 1,800													
	Signal Coordination/EMS Devices/Overhead Street Name Signs/Signal Back Plates/Communications Synchronization	36	$ 9,000	$ 324,000													
	Add Dual Lefts on Cross Street				1	$ 46,400	$ 46,400										
	Add Left-Turn Lane on Cross Street				1	$ 54,500	$ 54,500										
	Extend Existing Turn Bay on Cross Street				14	$ 32,400	$ 453,600										
	Widen Cross Street to 4 lanes 400 - 600' from FM 1960				2	$ 237,600	$ 475,200										
	Minor Driveway Modification													9	$ 8,400	$ 75,600	
	Major Driveway Modification													1	$ 21,700	$ 21,700	
	Add Bench at Bus Stop Location										18	$ 2,500	$ 45,000				
	Add Shelter at Bus Stop Location										5	$ 22,500	$ 112,500				
	TOTAL FOR SHORT RANGE IMPROVEMENTS			**$ 4,014,200**			**$ 1,029,700**			**$ -**			**$ 157,500**			**$ 97,300**	**$ 5.30**
Medium Range	Add Right Turn Lane	3	$ 106,600	$ 319,800													
	Right Turn Lane Extension	2	$ 32,400	$ 64,800													
	Add Sidewalks	2	$ 33,600	$ 67,200													
	Add Dual Lefts on Cross Street				2	$ 46,400	$ 92,800										
	Add Right-Turn Lane to Cross Street				6	$ 54,500	$ 327,000										
	Widen Cross Street to 4 lanes				5	$ 237,600	$ 1,188,000	1	$ 2,509,100	$ 2,509,100							
	Major Driveway Modification													36	$ 21,700	$ 781,200	
	Shared Driveway													1	$ 39,100	$ 39,100	
	Connect Adjacent Properties													19	$ 25,000	$ 475,000	
	Add Sidewalks from Bus Stop to Intersection										4	$ 13,800	$ 55,200				
	TOTAL FOR MEDIUM RANGE IMPROVEMENTS			**$ 451,800**			**$ 1,607,800**			**$ 2,509,100**			**$ 55,200**			**$ 1,295,300**	**$ 5.92**
Long Range	Grade Separation	2	$ 16,500,000	$ 33,000,000													
	New Roadway by Harris County				0.45 mi	$ 4,400,000	$ 1,980,000										
	New Roadway by Developers													1.12 mi	$ 4,400,000	$ 4,928,000	
	TOTAL FOR LONG RANGE IMPROVEMENTS			**$ 33,000,000**			**$ 1,980,000**			**$ -**			**$ -**			**$ 4,928,000**	**$ 39.91**
	GRAND TOTAL		**$**	**37,466,000**		**$**	**4,617,500**		**$**	**2,509,100**		**$**	**212,700**		**$**	**6,320,600**	**$ 51.13**

Table 7.1 - Cost estimate summary

Note: Specific improvement types and locations can be found in Section 5 of the report.

Implementation Strategies on FM 1960

The recommended projects identified in this plan have been categorized as short-, medium-, or long-range in nature. Table 7.1 summarizes the projects and costs. A planning-level, construction cost estimate was prepared for each improvement type. High and low costs for each improvement type were developed. This cost does not include utility relocations or right-of-way acquisition. The actual cost will vary due to circumstances specific to each location. For this study, the average of the high and low costs was used for the purposes of summarizing the anticipated costs by agency. Due to some overlap in jurisdiction, both a primary and secondary responsible party was shown for the proposed improvements.

Phase One

The agencies should immediately adopt this plan and incorporate the proposed improvements into their respective Capital Improvement Programs in order to secure funding for the proposed improvements.

As stated previously, to realize the maximum benefit from the recommended improvements, the study encourages all of the agencies to move forward with both short- and medium-range projects since, as discussed in Section 6, the model considered both in the analysis.

Phase Two

The study recommends the creation of a FM 1960 area management district to ensure collaboration between the agencies, private developers and businesses along the corridor. A management district would be especially important when agencies seek to implement projects that require buy-in and cooperation from the private sector, such as driveway modifications, internal connections and projects that require additional right-of-way.

The management district also should seek to enhance the streetscape through landscape treatments, which will improve the image of the area and encourage implementation of the long-term corridor vision identified in Chapter 8.

Potential funding sources for landscape improvements include Statewide Transportation Enhancement Program funds, TxDOT landscape funds, Trees for Houston and private sector contributions.

All landscape enhancements such as street trees, parking lot shrubbery and median plantings should meet a high standard of quality and have provision for watering during the establishment period as well as an ongoing maintenance plan.

Streetscape improvements, such as informational signs, signals, streetlights, benches and pedestrian/bicycle facilities, also could be coordinated with public entities in order to help establish a positive identity for the area.

Phase Three

The FM 1960 area can experience enhanced mobility, improved livability and opportunities for economic development by developing a balanced system of different types of roadways and transit modes as identified in Section 8 - Express Streets Concept - A Vision for Redevelopment.

A management district would help the area to work with the City of Houston Planning Department to coordinate platting approval for new and redevelopment along the corridor to ensure that changes in area infrastructure and development do not compromise access and mobility on FM 1960 and are in-line with the Express (Smart) Street redevelopment concepts.

In addition, agency coordination is essential in managing access. FM 1960 is a prime example of a multi-jurisdictional facility, whereby the State owns the facility but operation of the roadway is managed by TxDOT in the unincorporated areas and the City of Houston in the incorporated areas. Furthermore, Harris County owns and operates most of the cross streets, including all of the major intersecting roadways along FM 1960, and METRO operates bus services along the roadway.

It is recommended that the City of Houston Planning Department coordinate with the Texas Department of Transportation and Harris County before approving any plat that impacts access to this roadway.

It is further recommended that public agencies program the long-range projects identified in this study in order to ensure funding and take all necessary steps to plan for the implementation of identified long-range projects, including performing preliminary engineering and attaining environmental clearance in a timely manner.

Regional Access Management Strategy

Transportation agencies are faced with the perpetual challenge of providing an efficient and safe transportation system in a time of funding shortfalls, rising costs, environmental and development constraints and sometimes even public opposition.

More than ever, these agencies realize that it is not possible to build a community's way out of congestion and safety problems. As a result, agencies are seeking more efficient ways to operate their transportation systems in order to achieve maximum use and performance.

Regional access management programs have been adopted by numerous state and local transportation agencies and more are under development. A vast majority of the programs, especially those administered by local governments, involve the development and adoption of access management policies and guidelines regulating and enforcing proper land use and transportation planning, public works projects, subdivision regulation, impact assessment and permitting. Local governments are well positioned to develop and enforce comprehensive access management programs.

Coordination

Coordination and collaboration is critical for an access management program to work effectively. Access management decisions affect all of the transportation agencies - from program development through the permitting process. Coordinated procedures help to ensure regular and consistent involvement and consensus among responsible parties. A lack of coordination can lead to frustration for the affected parties and ultimately can damage an agency's credibility.

Issues of Concern

Property owners and developers needs vs. public needs - The need to provide a safe and efficient roadway often conflicts with a developer's desire to have unlimited and convenient access. In this region, developers are not held accountable to ensure that their development does not adversely impact the traffic in the area and that their needs do not adversely impact public needs.

Agency's obligations to provide access - It is incumbent upon transportation agencies to provide access to platted parcels of land. In our area, land use and platting approval, which controls the configuration and intensity of development, are vested with the municipality. The state and county need to develop coordinated guidelines with the municipality to ensure that access management is an integral part of the plat approval process.

Joint support between agencies - Inter-agency support and improved communication is critical to a successful access management program. The agencies need to collectively resolve how to review and approve developers' and property owners' requests for access.

Driveway permitting and design requirements - The permitting process needs to be reviewed and updated regularly to keep pace with the ever changing development. Monitoring these permits could ensure that the original permit conditions and previous agreements with developers and property owners are still applicable. Driveway design standards and specifications should be reviewed periodically to respond to frequently occurring driveway design issues.

Developing the Program

In order to address the region's access and mobility concerns, this study recommends the formation of an Access Management Task Force.

This Task Force, consisting of affected agency representatives, would be established in order to:

- Review and compile current procedures, practices and policies
- Coordinate with local decision makers
- Cultivate consensus among partner agencies and other affected parties and ensure that all partners are fully vested in the program
- Recommend *'best practices'* for consideration by local governments and transportation agencies.

Policies and Practices

Access management techniques can be addressed through both retrofit and policy actions. The basic policy issues are:

- Classify roads based on the thoroughfare plan
- Establish access and geometric standards for each class of roadway
- Limit access along major arterials
- Restrict left turns where arterial access is provided

Any access control or management plan must be done system-wide to avoid shifting problems. The region must develop comprehensive access management guidelines in order to maximize the efficiency of their transportation systems. These guidelines can define or limit the application of specific techniques. One idea is for these agencies to establish an office for access management; this office will study and develop recommendations for land use planning, engineering and legal practices related to access management issues. Another effective tool is to utilize the permitting process and the review of developments and plats to ensure that good access management practices are being implemented consistently and fairly throughout the area in new and redevelopment areas.

Access Management Strategies

- Straight forward
- Coordinated
- Consistently applied

SECTION 8

THE EXPRESS STREET CONCEPT

A Vision for Redevelopment

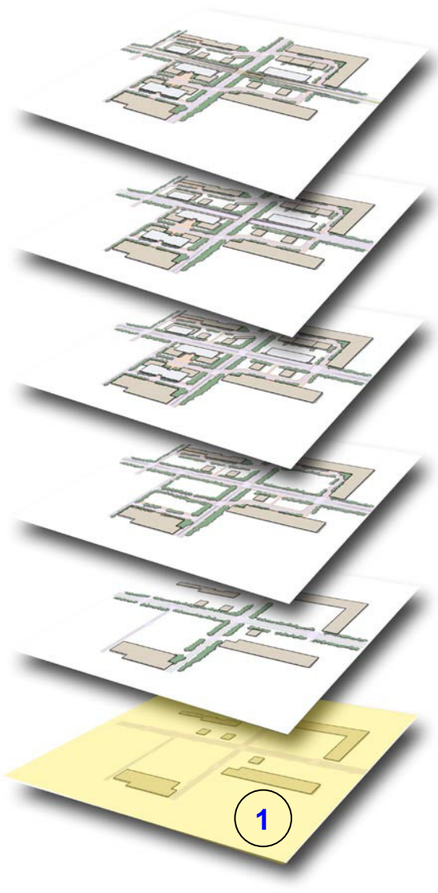
RETROFIT PROCESS

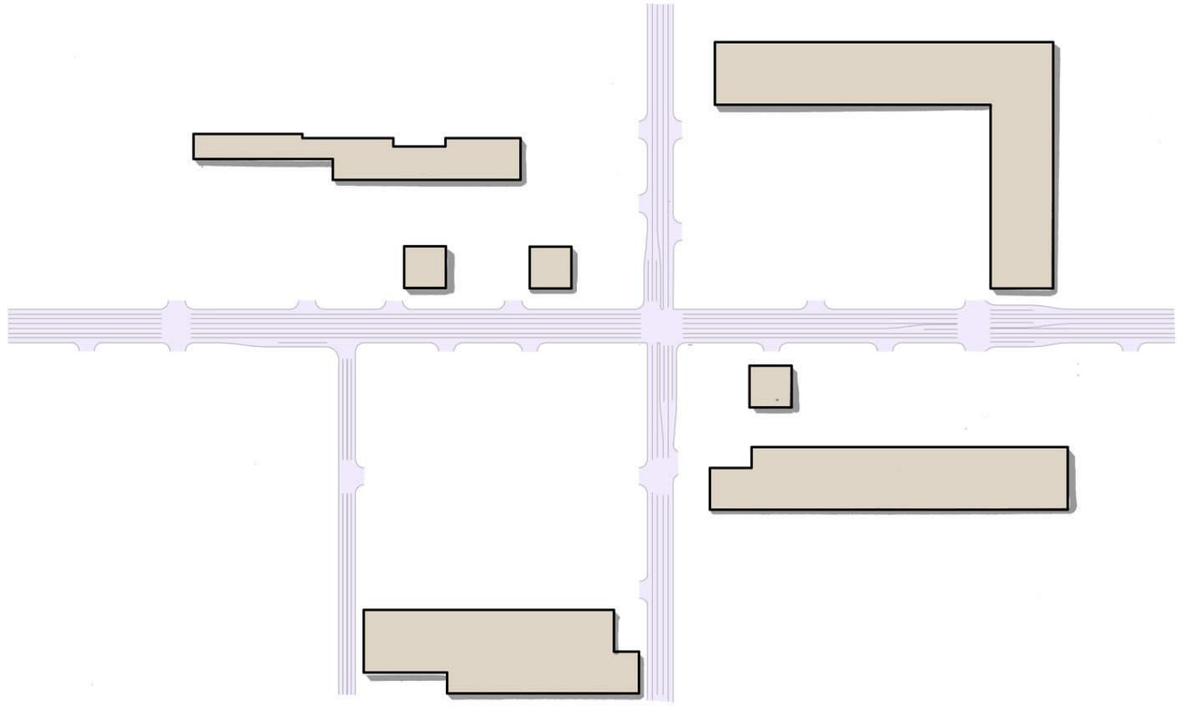
The retrofit process refers to the potential phasing that could take place along existing corridors in order to implement the express street concepts. The following six phases of redevelopment are described in more detail in the following section: **(1)** from existing conditions, **(2)** basic access management **(3)** alternate routes and modes, **(4)** infill redevelopment, **(5)** grade separations, and **(6)** high capacity transit.

The ultimate phase accomplished for a particular corridor will be dependent upon available right-of-way, and public policies surrounding maximum densities, mix or separation of uses, and architectural guidelines. It is anticipated that the majority of the express street corridors in Houston will reach an ultimate retrofit of Phase II, III, or IV.

Phase I
Existing Conditions

The series of images on this page and the following pages shows the possible retrofit of a prototypical suburban arterial lined with commercial centers. The process begins with the existing conditions; single-story shopping plazas set back far from the street with large parking lots and many driveways. Minimal landscaping, numerous overhead utility lines, constrained right-of-way and intermittent sidewalks characterize this phase. Roadway widening is an expensive option and the corridor is mature and showing its age.



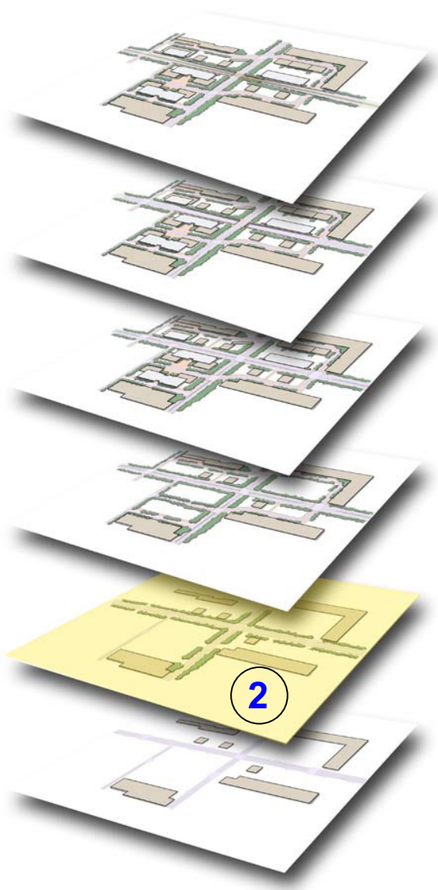


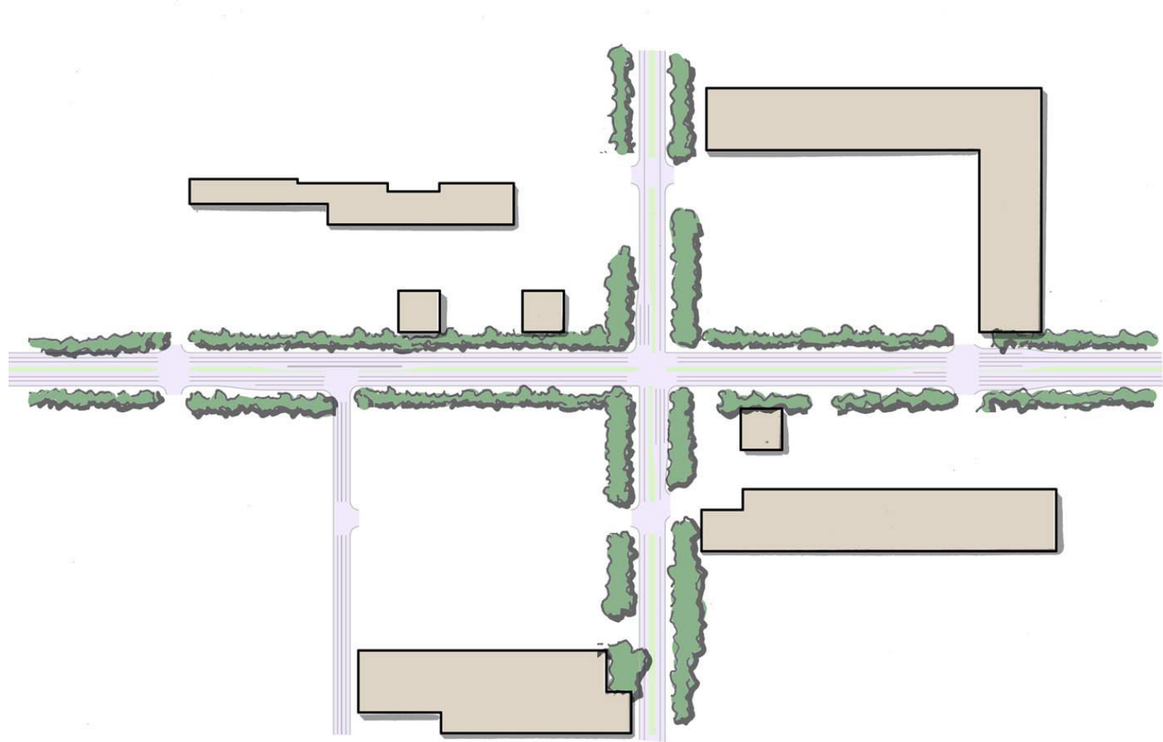
Phase II
Basic Access Management

Phase II improvements are entirely within the existing public right-of-way. As such, public entities have the most control over these types of projects.

The first step is to minimize curb cuts and to close driveways where multiple access points to a single property exist. The consolidated access points are enhanced through improved signage, sight distance, and capacity.

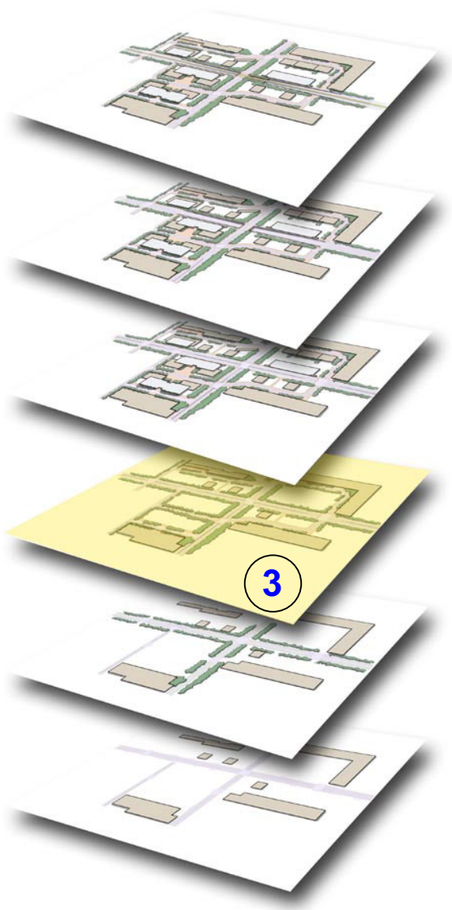
Additionally, better amenities are provided along the roadways in the form of sidewalk and landscaping improvements.

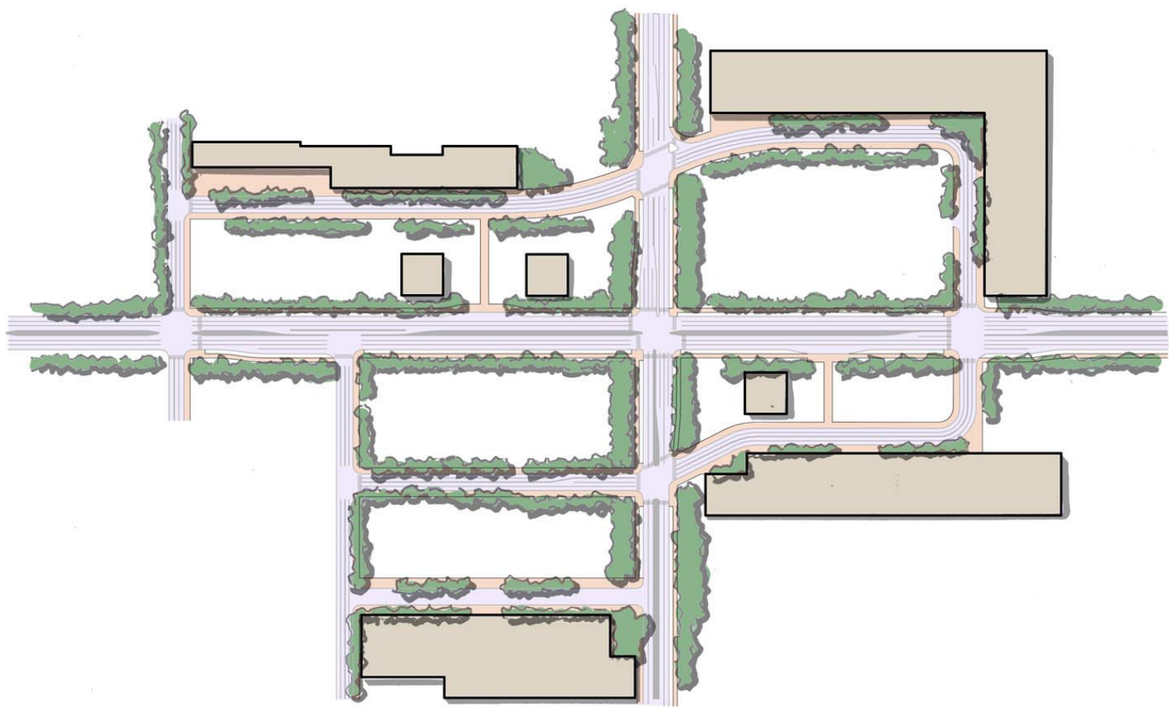




Phase III
Alternative Routes and Modes

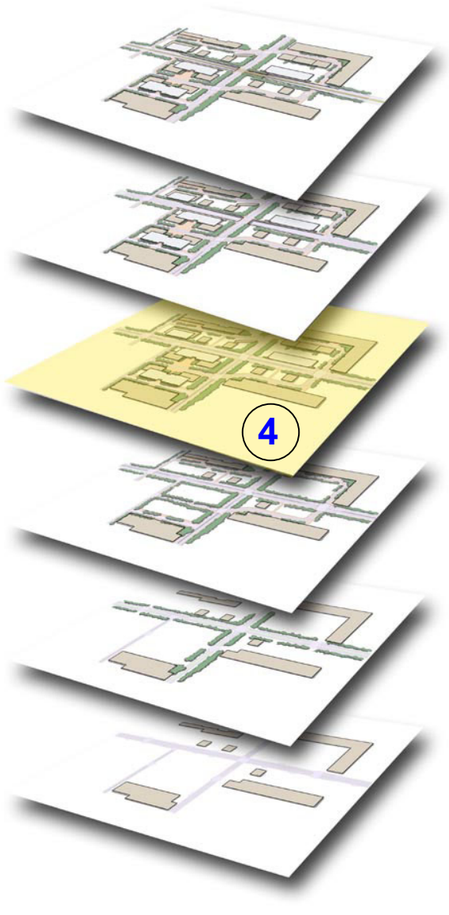
Phase III starts to impact areas that are currently in the private realm. Through the creation of backage roads, these streets could be privately or publicly, constructed or maintained, but they would need to be developed in such a way to be universally accessible. Additional pedestrian facilities would be provided along roadways, including identifiable crosswalks at intersections. The sidewalk network would be completed, bus pull-outs would be built, and medians along arterials developed. Pedestrian connections between bus stops and commercial areas would also be created.





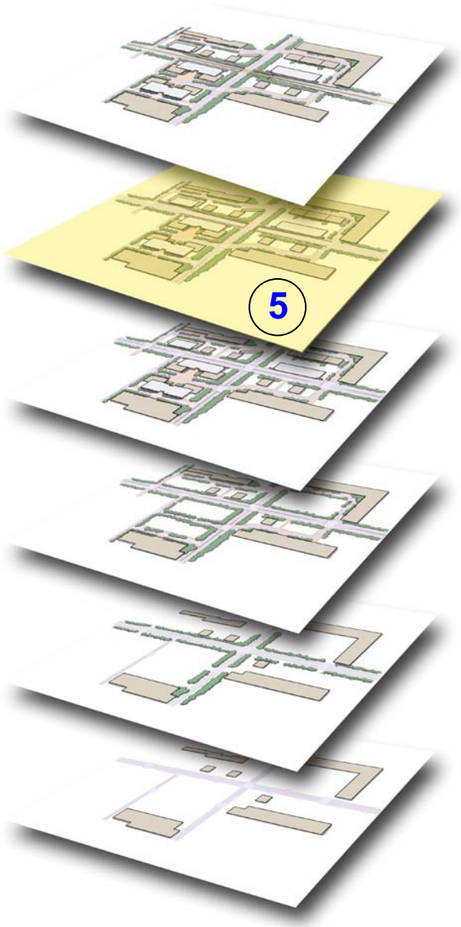
Phase IV
Infill Redevelopment

Phase IV involves extensive private participation in order to create higher quality, higher intensity development. Public entities would encourage infill development and improved urban design standards through localized land use policies and architectural guidelines.



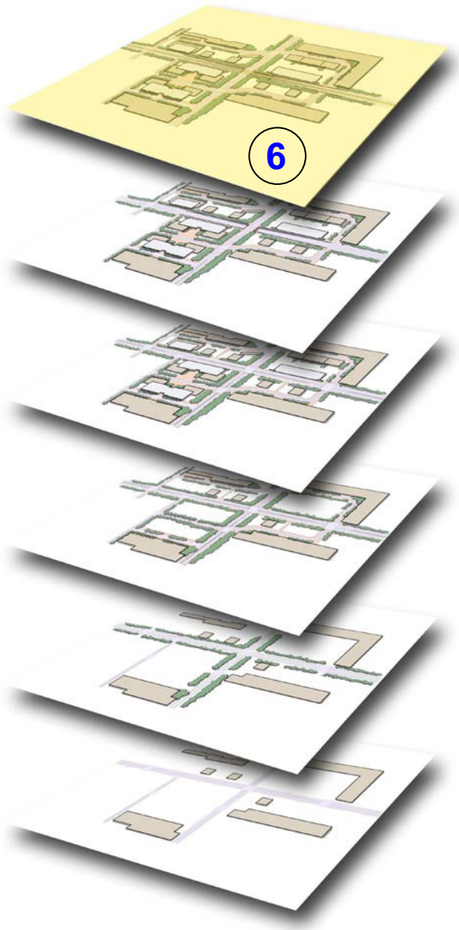
Phase V
Grade Separations

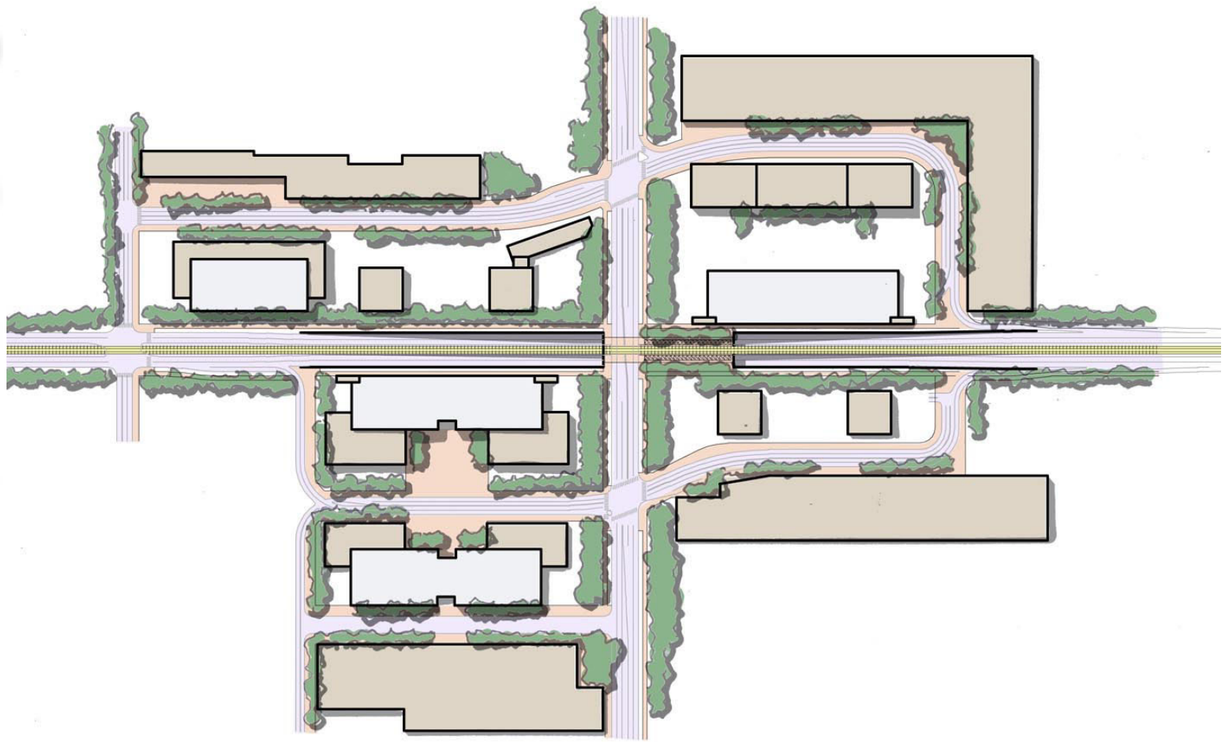
Phase V moves back into the public realm. With increased development, traffic volumes at intersections may reach a level where grade separation is warranted. The principal express street would be grade separated so that through traffic would not be required to stop. It is highly likely that additional right-of-way would be required to accomplish most grade separations. Bus routes could be relocated to the backage roads, making access to transit even easier for retail patrons and local residents.



Phase VI
High Capacity Transit

In some corridors, development may reach a level at which high capacity transit can be supported. High capacity transit can range from express bus service or bus rapid transit to light rail or mono-rail. This example shows the express street grade separated (through an underpass) with a light rail station at ground level





PROTOTYPE ALTERNATIVES

In exploring the express street concept it was important to examine how the concept might be applied to an actual corridor in the Houston area. To that end, a charrette was conducted to develop prototypical alternatives in the FM 1960 corridor in northwest Houston.

Two sites were selected based upon different adjacent land use arrangements and the availability of traffic counts. The sites were approximately one-half mile long centered on major intersections so that both access management and intersection management tools could be applied. Actual sites were used to make the alternatives as "real world" as possible. However, the alternatives are considered prototypical and not actual proposed redesigns of the locations in question.

Case Study: FM 1960

Existing Conditions

FM 1960 is an east-west state-owned highway that extends from US 290 in northwest Harris County to US 90 in Liberty County. The segment under study is a 7.1-mile principal arterial between SH 249 and IH 45 passing mainly through an unincorporated area of Harris County.

The typical section of the roadway consists of three travel lanes in each direction, as well as a center two-way left turn lane and intermittent narrow sidewalks, all within 100 feet of right-of-way. The corridor is largely suburban in character with mature single-story strip shopping centers and moderate density multi-family residential developments. Driveways and traffic signals are frequent. The edge of the roadway is lined with utility poles, billboards, and large commercial signs.

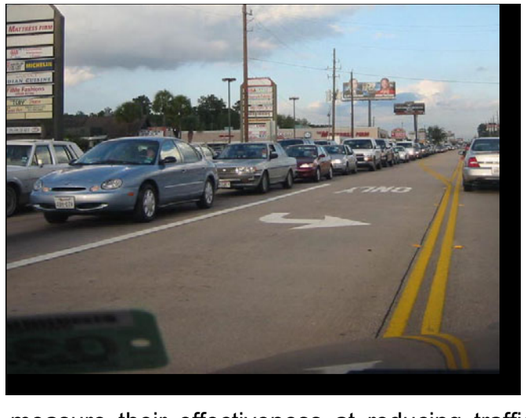
Bidirectional traffic volumes on FM 1960 are in excess of 67,000 vehicles per day, leading to severe congestion during weekday commuting peaks and midday on Saturdays. Transit service consists of the Route 86 Metro bus which runs at 15 minute headways during peak periods, and 30 minute headways off-peak.

Why FM 1960?

The existing conditions described above paint a vivid picture as to why FM 1960 is an excellent choice for study. It is a classic example of a principal arterial street that has frequent access points to adjacent properties and frequent traffic signals. These two delay-inducing elements reduce FM 1960's performance for longer distance regional trips. Furthermore, the adjacent land uses generate many local and regional trips resulting in congestion.

Other reasons that FM 1960 is an interesting case study are the variety of adjacent land uses the corridor serves — from single-family homes and apartment complexes to suburban commercial development to areas of undeveloped land. Development along the corridor has matured to the point that opportunities may exist for focused redevelopment. However, due to right-of-way constraints, widening may not be feasible, therefore, more efficient use of the existing roadway width is necessary.

The following are four prototypical concepts developed for the FM 1960 Corridor. The first concept is the roundabout which uses the intersection of FM 1960 and T. C. Jester as a template. The remaining three concepts use FM 1960 at Kuykendahl Road as a basis. Microsimulation was used on the Backage Road and Grade Separation concepts



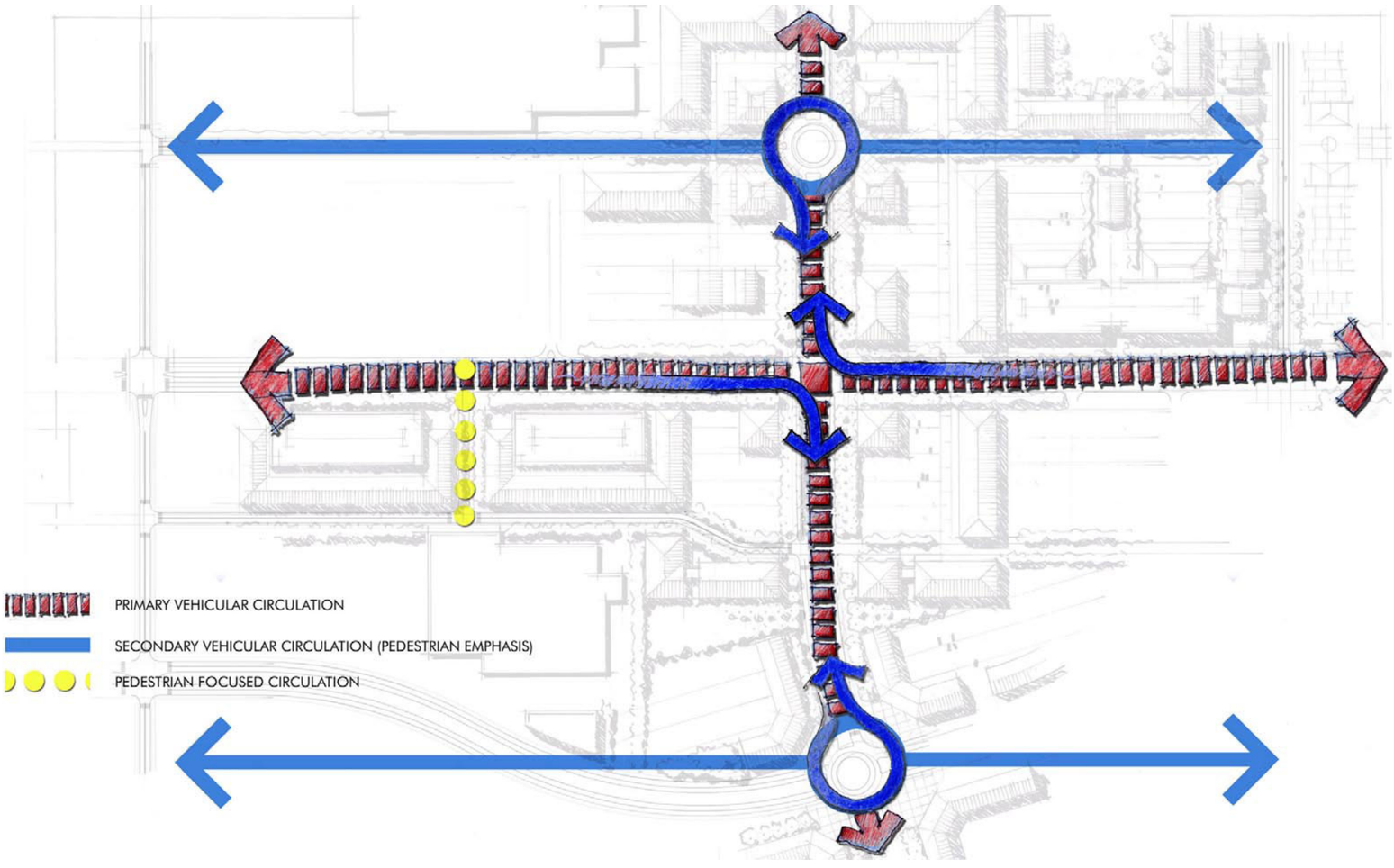
to measure their effectiveness at reducing traffic congestion.

ROUNDABOUT CONCEPT

Circulation Diagram

The Roundabout Concept uses the intersection of FM 1960 and T.C. Jester as a guide. The concept is considered prototypical and not a proposed redesign of the site. A variety of tools from the express street toolbox are employed.

FM 1960 Express Streets				
Conceptual Cost Estimates				
Roundabout Concept				
Item	**Qty**	**Units**	**Unit Cost**	**Ext Cost**
Roundabouts (landscaped, including ROW)	2	EA	$1,000,000	$2,000,000
Median closure	2400	LF	$50	$120,000
T-Intersection (excl signal)	1	EA	$40,000	$40,000
Signal upgrades	3	EA	$50,000	$150,000
Signal interconnect	2400	LF	$ 40	$96,000
Extend parallel street, 4 lanes, raised median	1500	LF	$500	$750,000
Backage street curb retrofit	6200	LF	$20	$124,000
New sidewalks	9000	SY	$40	$360,000
Undergrounding utilities	2400	LF	$100	$240,000
Street trees	200	EA	$250	$50,000
Bus shelters	2	EA	$10,000	$20,000
				$ -
TOTAL				$3.95 Million



ROUNDABOUT CONCEPT

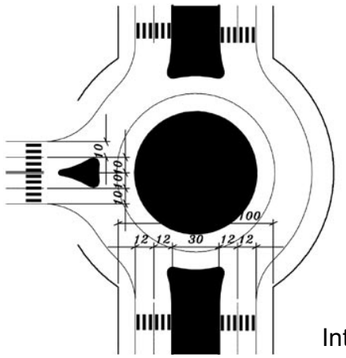
Transportation

Left turns from FM 1960 (the principal express street) would be denied. In order to turn left from FM 1960 one would turn right and change directions using the roundabout. This configuration is known as a bowtie intersection, which improves traffic by permitting more “green time” in the east-west direction. The green time would not be interrupted to provide protected left turns.

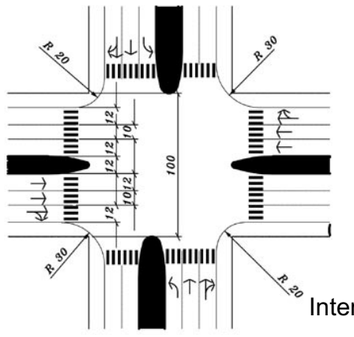
To reduce side friction, driveways would be consolidated to reduce the number of places turning movements could occur. In addition, a raised median would be installed to replace the center left turn lane. The median would limit left turn locations from FM 1960, as well as from driveways.

The parallel street network would be completed providing access to adjacent commercial development and creating alternative paths to get places. Parallel streets would intercept local trips, thus maximizing efficiencies of the express street.

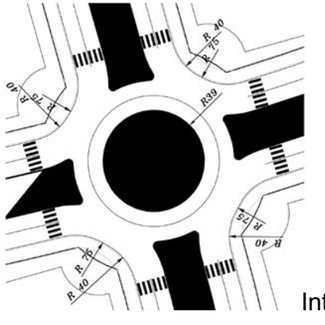
Signals would be spaced at 1,100 to 1,600 feet and coordinated to progress traffic along FM 1960 in the peak direction.



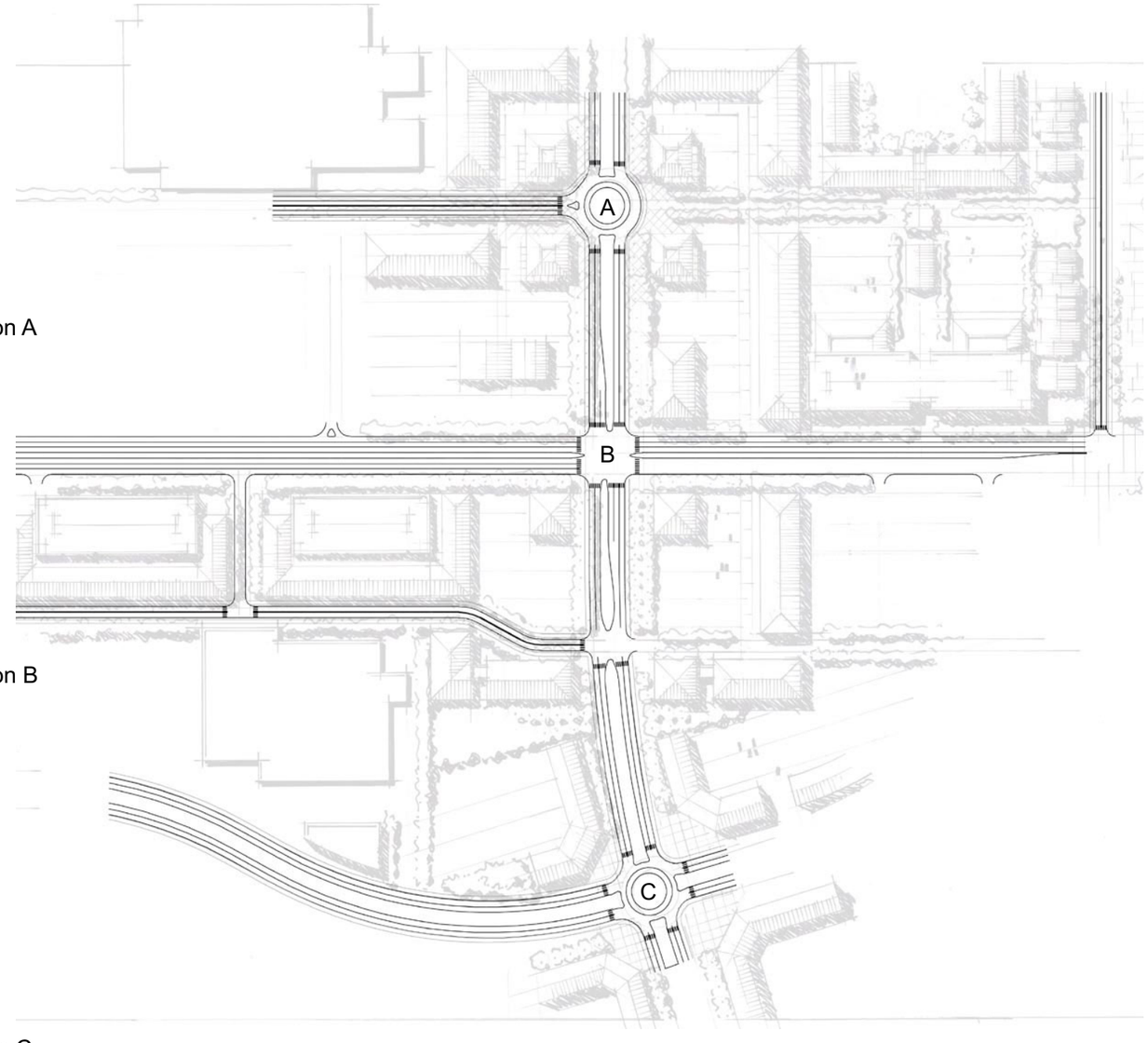
Intersection A



Intersection B



Intersection C

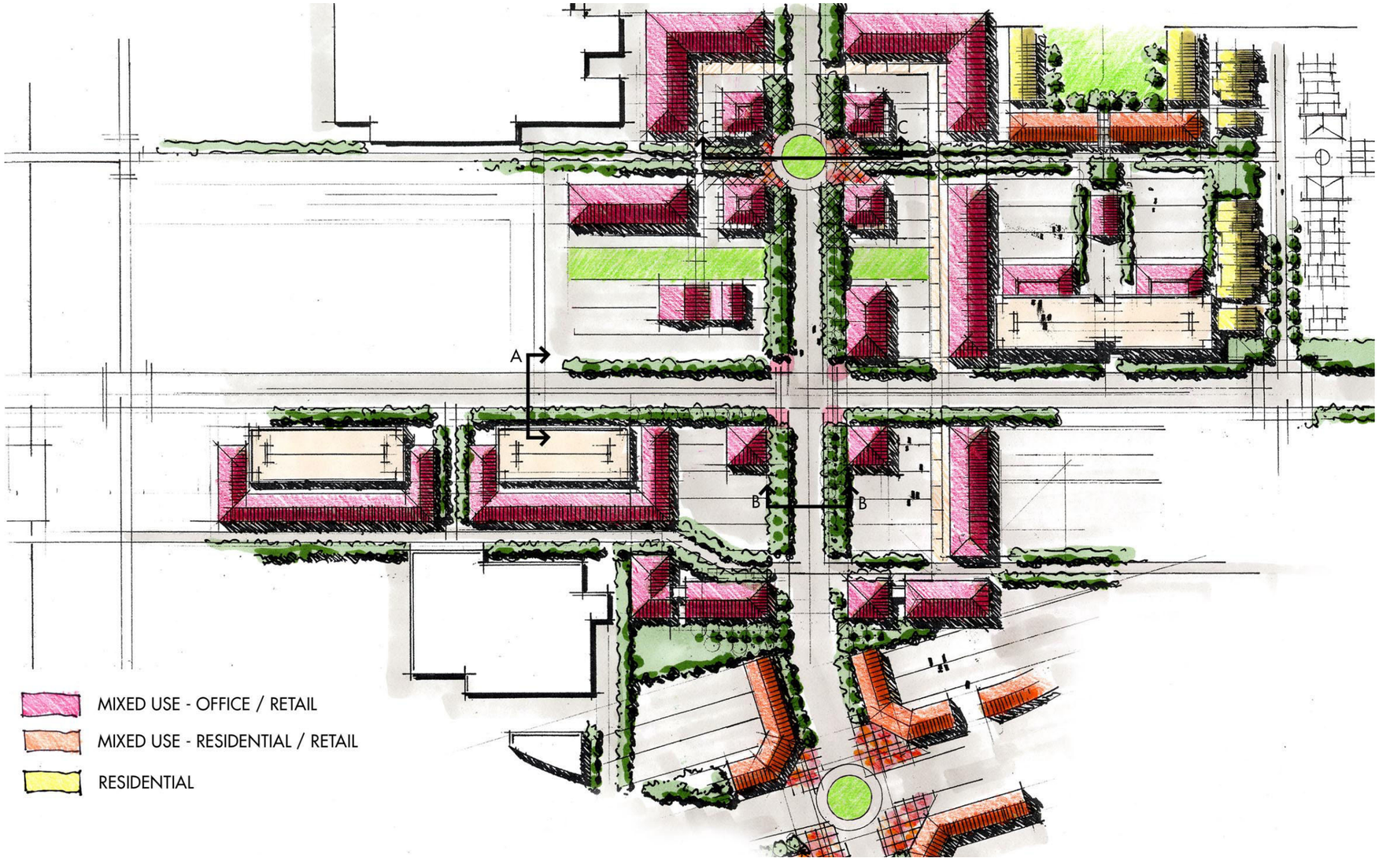


ROUNDABOUT CONCEPT

Development Prototype

The transportation solutions of the Roundabout Concept provide the first of a series of steps leading to a long range redevelopment pattern that includes a mix of land uses. Office, retail and residential land uses would occur in mixed-use developments that emphasize the street edge while blending into existing development.

The new mixed-use developments would replace portions of existing surface parking lots fronting the secondary arterials and accommodate parking needs in internal parking garages. The structured parking facilities would be built with ground floor retail, or incorporated as internal structures within the mixed-use developments. At the intersections of the primary and secondary arterials, pad sites with surface parking would still be allowed to exist.



ROUNDABOUT CONCEPT

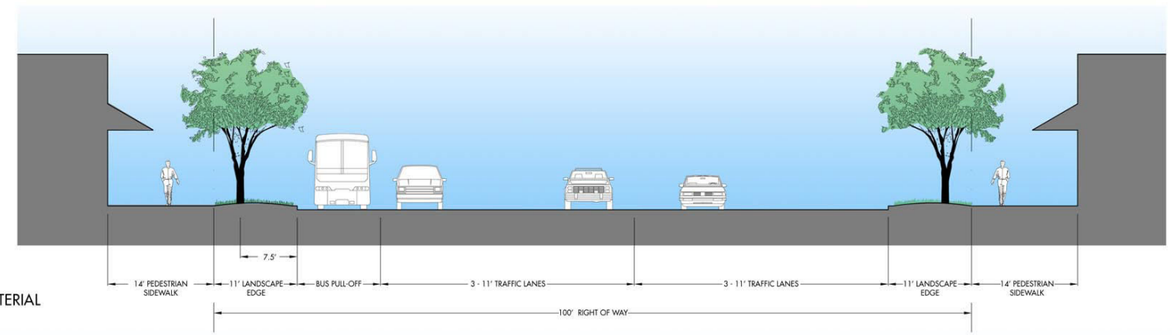
Urban Design

The primary artery would be framed with an 11-foot landscape edge and street tree planting concentrated towards the interior side. An ample 14-foot wide pedestrian sidewalk would front development. Minimal street furnishing amenities would be necessary along this frontage.

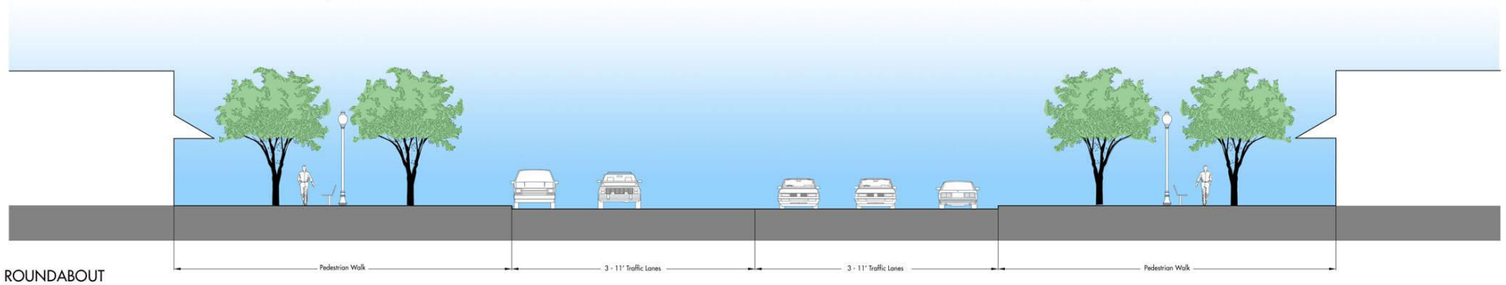
The frontage along the secondary arterial would provide a broad promenade from the curb to the adjacent development. The promenade would contain a double canopy of street tree plantings. Pedestrian lighting and street furnishings within and along the center spine of the promenade would create clear walk zones along both the street-side and development side.

The roundabout median would create an identifiable public open space with the potential for civic, landscape, or monumental enhancements. A continuation of the broad promenade would frame the adjacent nodal development opportunity.

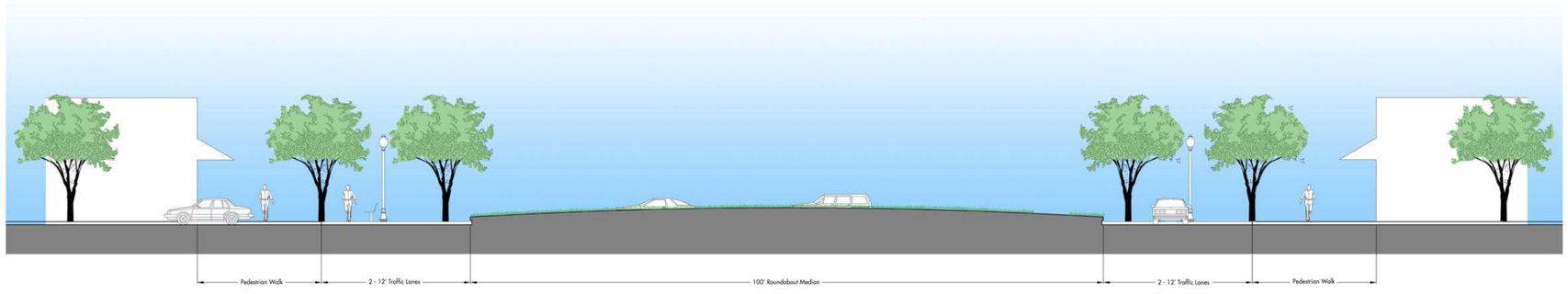
SECTION A. FM 1960



SECTION B. SECONDARY ARTERIAL



SECTION C. ROUNDABOUT

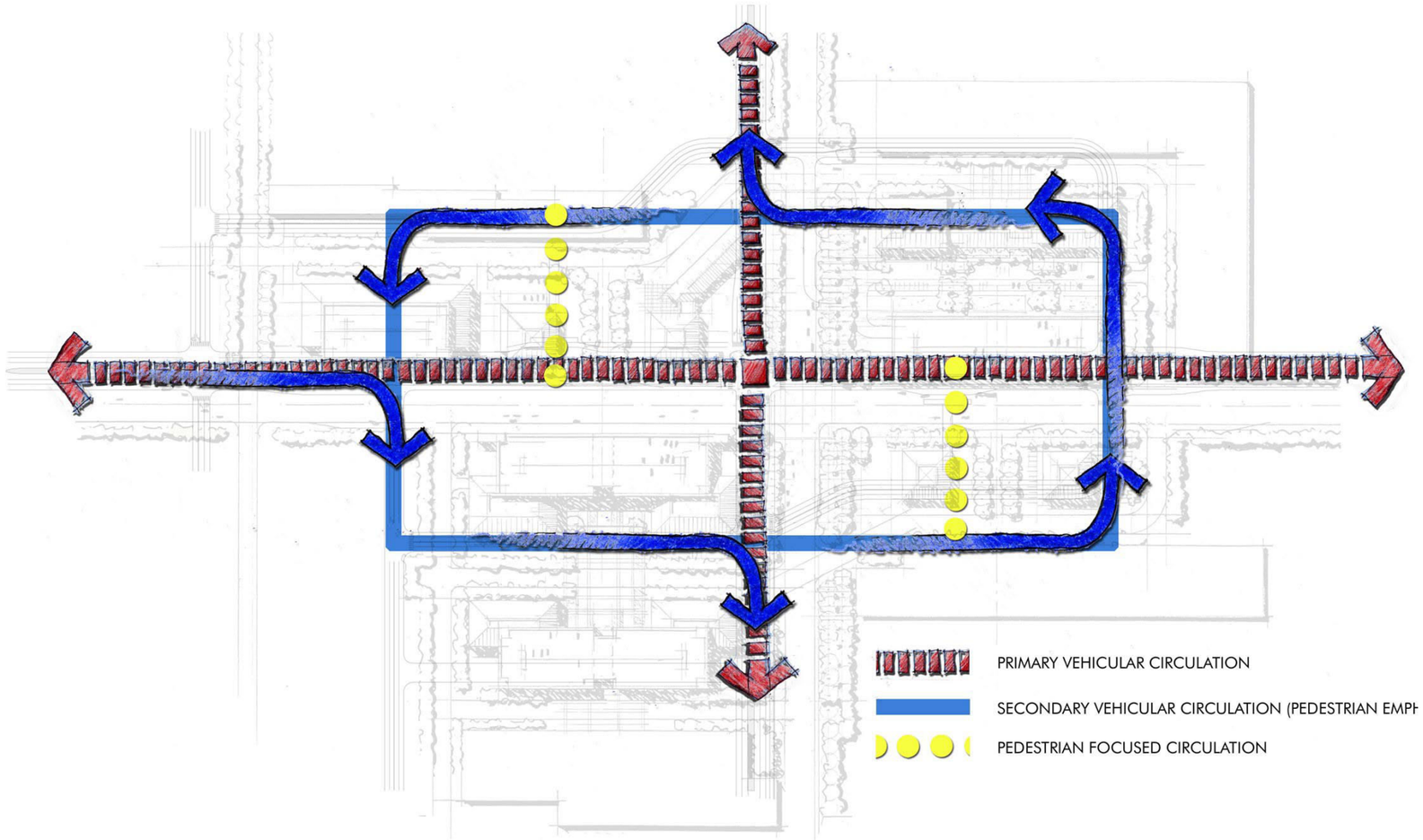


BACKAGE ROAD CONCEPT

Circulation Diagram

The Backage Road Concept uses the intersection of FM 1960 and Kuykendahl Road as a template. As this intersection is currently programmed for grade separation, the concepts are not proposed for implementation but to explore ideas and to serve as an example.

FM 1960 Express Streets				
Conceptual Cost Estimates				
Backage Road Concept				
Item	**Qty**	**Units**	**Unit Cost**	**Ext Cost**
				$ -
Median closure	2500	LF	$50	$125,000
T-Intersection (excl signal)	1	EA	$40,000	$40,000
Signal upgrades	1	EA	$50,000	$50,000
New signals	2	EA	$100,000	$200,000
Signal interconnect	3300	LF	$40	$132,000
Driveways	15	EA	$2,000	$30,000
Backage roads	4400	LF	$400	$1,760,000
New sidewalks	8000	SY	$40	$320,000
Undergrounding utilities	3300	LF	$100	$330,000
Street trees	100	EA	$250	$25,000
Bus pullouts	2	EA	$20,000	$40,000
				$ -
TOTAL				$3.1 Million



BACKAGE ROAD CONCEPT

Transportation

The Backage Road Concept would deny all turns from FM 1960 onto Kuykendahl Road. Instead, turning vehicles would use a set of "backage" roads constructed parallel to FM 1960 and adjacent to the existing commercial buildings. Transferring turning movements to the backage road is a variation on the jughandle intersection. This unconventional intersection type would improve traffic movement by permitting more "green time" in the east-west direction since the green time would not be interrupted to provide protected left turns.

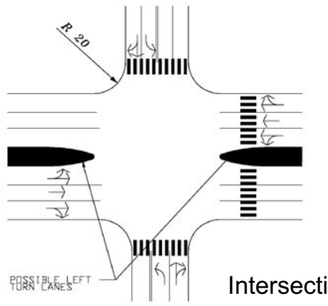
All driveway openings would be removed within approximately 1,000 feet of the intersection and driveway access would be from the backage roads. In addition, a raised median would be constructed replacing the center left turn lane. These changes would reduce side friction by controlling turning movements and preventing mid-block automobile crossings.

Transit service would be improved by creating bus pull-outs and enhancing amenities at the bus stops. Direct pedestrian connections from the bus stops to the retail buildings would be emphasized. Pedestrian safety and convenience would be improved at the intersections where the raised median would provide a mid-crossing refuge.

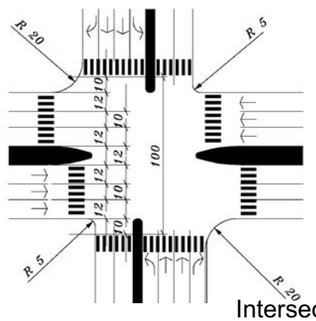
The backage roads would serve multiple purposes: they handle the turning movements from FM 1960, they serve as access to parking, and they enhance the shopping experience by creating a venue where community building could occur.

Traffic microsimulation was used to measure improvements attributable to the Backage Road Concept over existing conditions. While total distance traveled increased by diverting turns to the backage roads, total travel time decreased by 7 percent. Average speed increased by 8 percent, and total network delay decreased by 11 percent. Improvements to FM 1960 alone were even more substantial, although they were offset somewhat by deterioration of service for one direction on Kuykendahl Road.

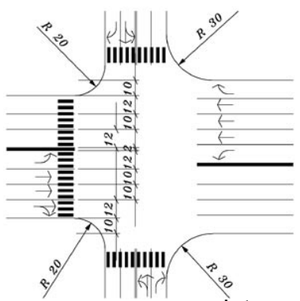
Denying turns from the express street at major intersections, would result in substantial improvements to travel time, average speed, and traffic delay benefiting the roadway network as a whole.



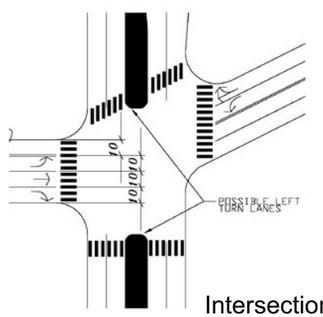
Intersection A



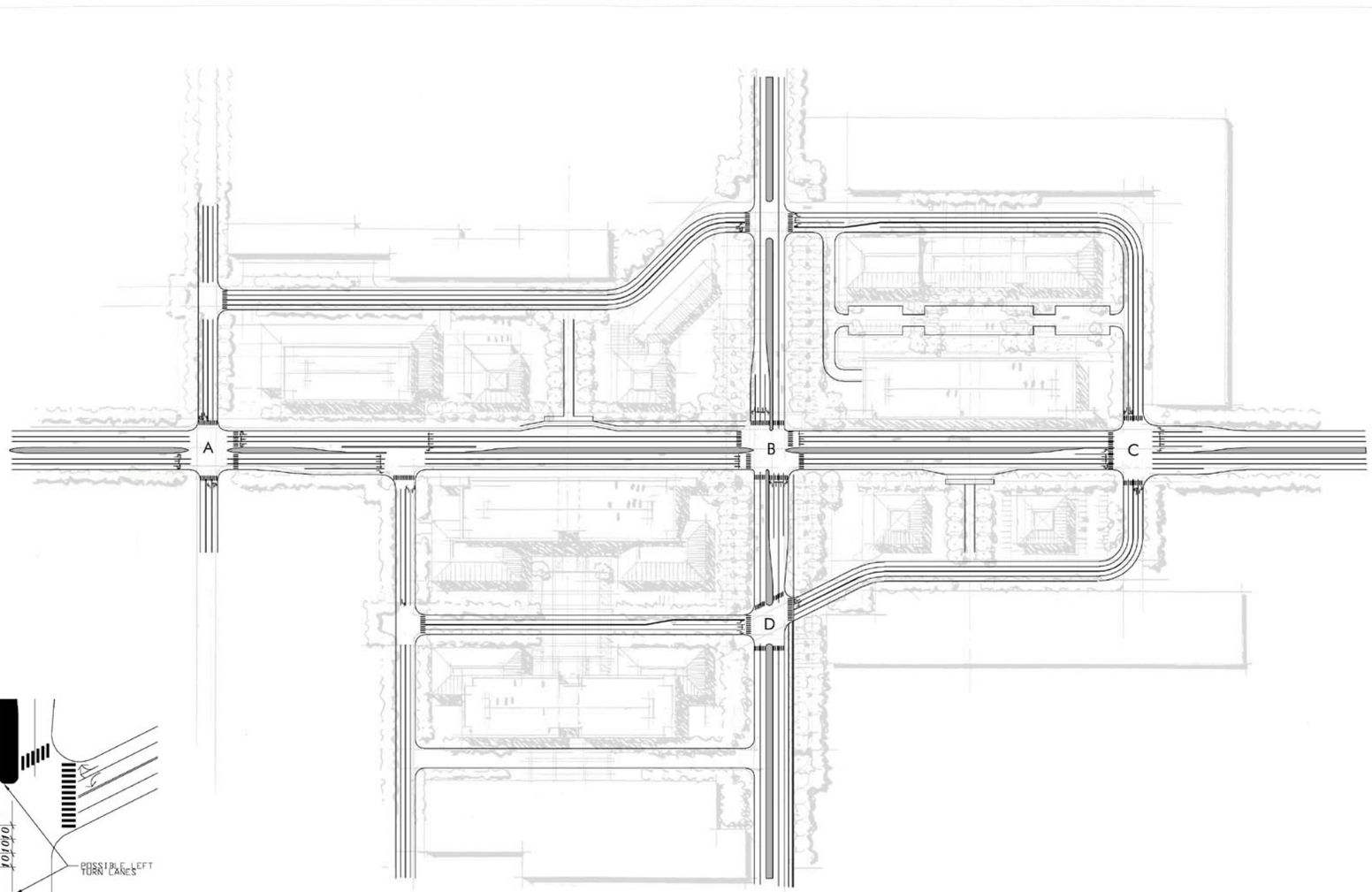
Intersection B



Intersection C



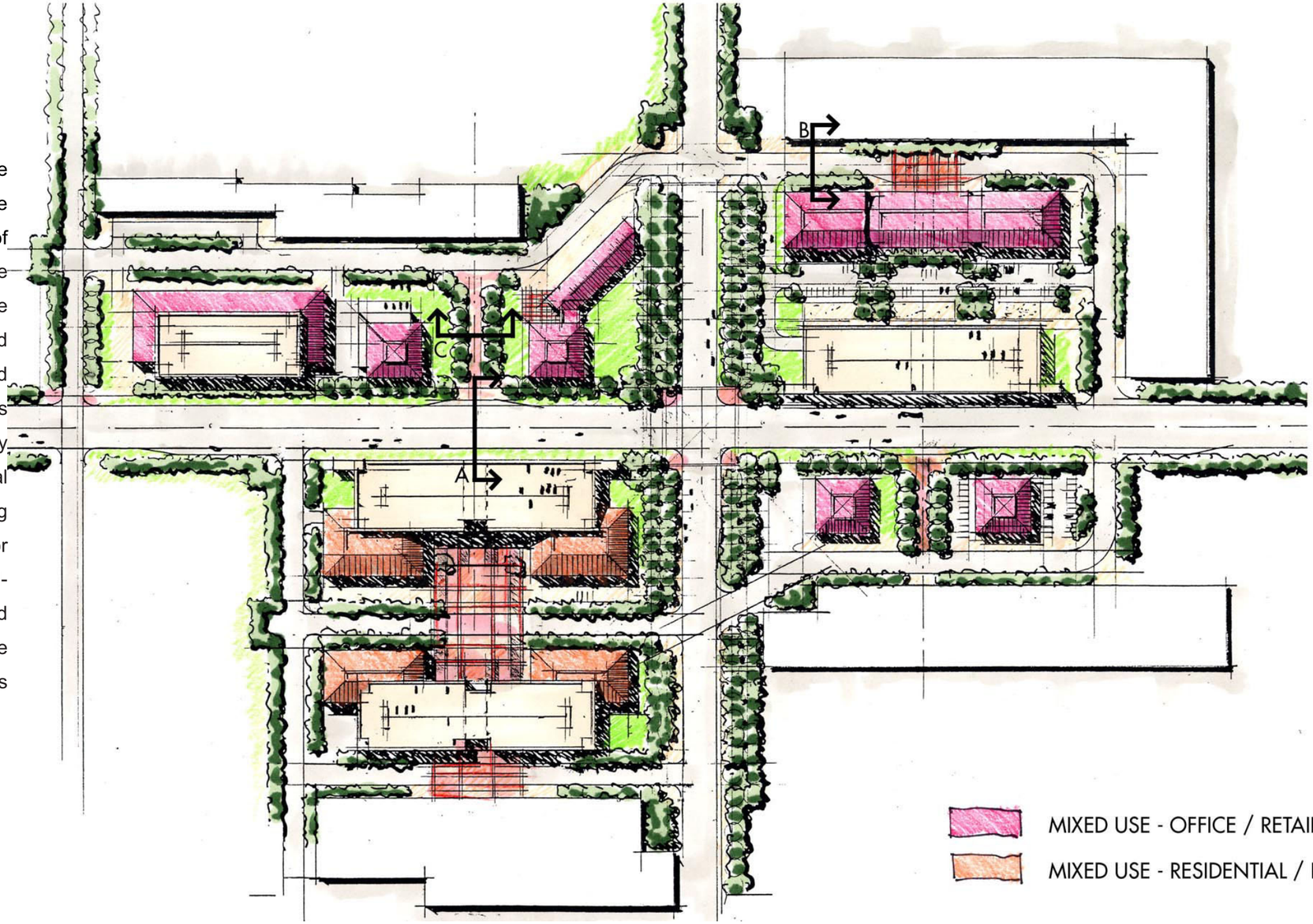
Intersection D



BACKAGE ROAD CONCEPT

Development Prototype

As in the Roundabout Concept, the Backage Road Concept would also lead to a long-range redevelopment pattern that includes a mix of land uses. Nodal "villages" would develop at the intersections of primary arterials, and would be energized by the visibility and accessibility created by the backage roads. The backage roads would become the new "Main Streets" for these villages and would become centers of activity supported by ground floor retail uses with office and residential uses on the upper floors. Structured parking facilities would be built with ground floor retail, or incorporated as internal structures within the mixed-use developments. Collector streets leading into and from the "villages" would allow access to the village from the surrounding residential neighborhoods without interfacing with any arterials.



BACKAGE ROAD CONCEPT

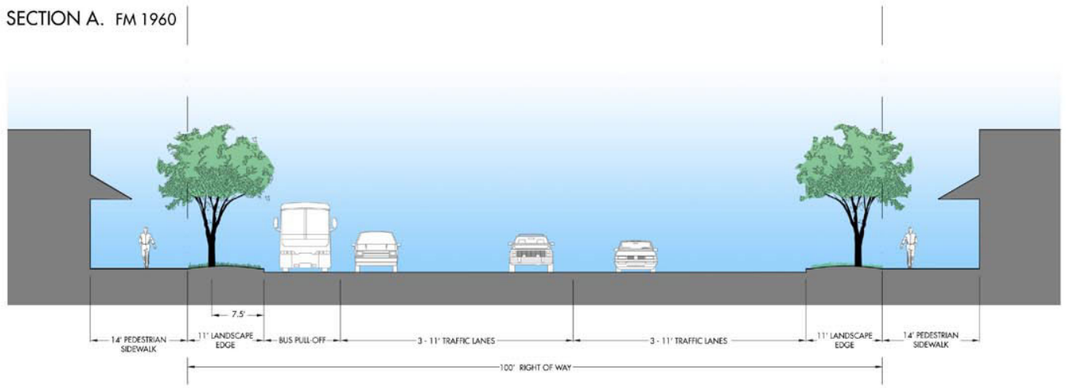
Urban Design

The primary artery would be framed with an 11-foot landscape edge with street tree planting concentrated towards the interior side. An ample 14-foot wide pedestrian sidewalk would front development, completing a connective visual aesthetic of development to the roadway environment. Minimal street furnishing amenities would be necessary along this frontage.

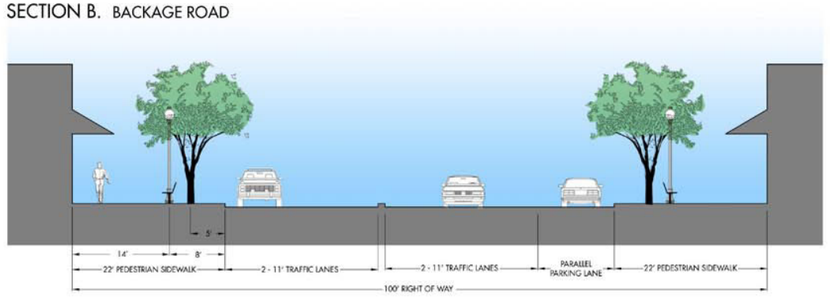
The backage road vicinity serves as the primary access from parking and on-street connection into new and existing developments oriented inward towards the backage road circulator. Continuous sidewalk connections from adjacent development to the backage roadway curb create a pedestrian promenade with ample street furnishings including benches, trash cans, pedestrian scaled lighting, and street trees.

Broad pedestrian corridor connections from the main arterial transit stop into the nearby developments would promote safety, accessibility and livability. These broad pedestrian corridors would contain a double lined row of tree plantings in conjunction with ample pedestrian-scaled lighting and bench amenities.

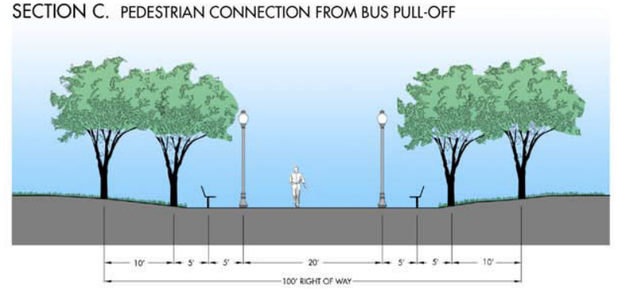
SECTION A. FM 1960



SECTION B. BACKAGE ROAD



SECTION C. PEDESTRIAN CONNECTION FROM BUS PULL-OFF

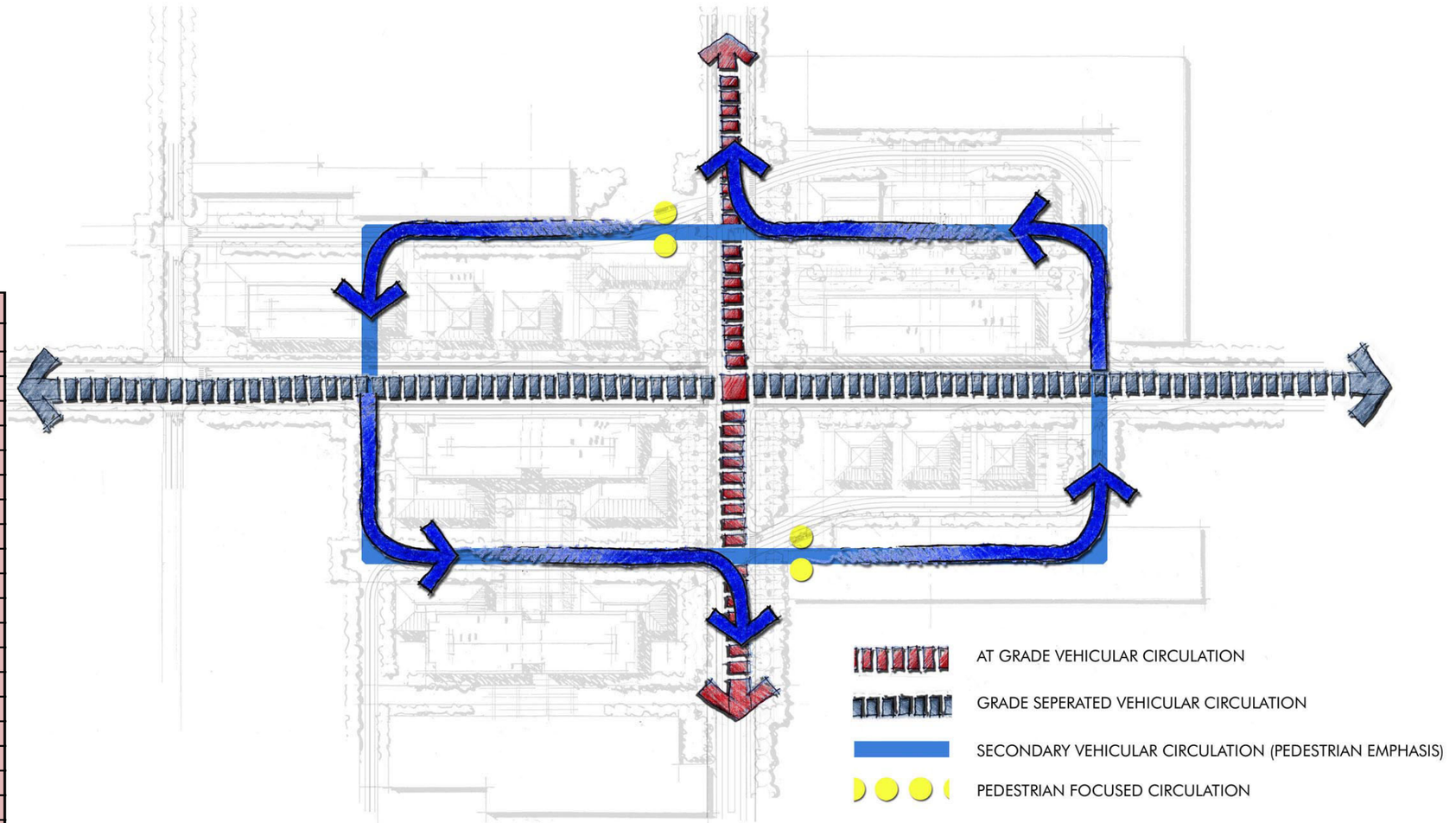


GRADE SEPARATION CONCEPT

Circulation Diagram

The Grade Separation Concept combines the backage road concept with a grade separation at FM 1960 and Kuykendahl Road. The grade separation explored here is different from the one currently programmed for this location and is intended as prototypical and not as a counterproposal.

FM 1960 Express Streets				
Conceptual Cost Estimates				
Grade Separation Concept				
Item	**Qty**	**Units**	**Unit Cost**	**Ext Cost**
Bridge	10000	SF	$100	$1,000,000
Retaining Wall	62500	SF	$35	$2,188,000
Rebuild roadway in underpass	2500	LF	$600	$1,500,000
Excavation	116000	CY	$10	$1,160,000
Right turn lanes	2	EA	$40,000	$80,000
New signals	2	EA	$100,000	$200,000
Signal interconnect	3300	LF	$40	$132,000
Driveways	15	EA	$2,000	$30,000
Backage roads	4400	LF	$400	$1,760,000
New sidewalks	8000	SY	$40	$320,000
Fencing	5000	LF	$20	$100,000
Undergrounding utilities	3300	LF	$100	$330,000
Street trees	100	EA	$250	$25,000
Bus pullouts	2	EA	$20,000	$ 40,000
Traffic Control	24	MO	$50,000	$1,200,000
Utility relocation	1	LS	$500,000	$500,000
ROW acquisition	0.5	AC	$1,000,000	$500,000
				$ -
TOTAL				$11.1 Million



GRADE SEPARATION CONCEPT

Transportation

With the Grade Separation Concept, all turns from FM 1960 onto Kuykendahl would be denied by the grade separation. Turning vehicles would use a set of backage roads constructed parallel to FM 1960 to access adjacent retail buildings. By grade separating, vehicles would not be required to stop at the crossing of FM 1960 at Kuykendahl Road. This would create a “permanent green” condition at this intersection.

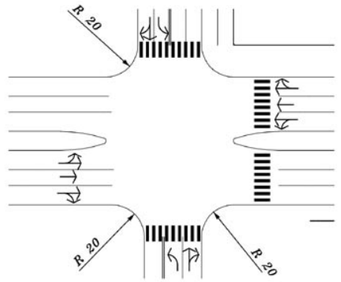
All driveway openings would be removed within approximately 1,000 feet of the intersection and driveway access would occur from the backage roads. This change would reduce side friction by controlling turning movements. Crossing FM 1960 other than at Kuykendahl would be impossible due to the depressed roadway.

Transit service would relocate to the backage roads with bus pull-outs and enhanced amenities at the bus stops. Pedestrian connections from the bus stops to the retail buildings would be more direct by virtue of proximity. Pedestrian safety and convenience would be improved where Kuykendahl crosses over FM 1960, as pedestrians would also have a “permanent green.”

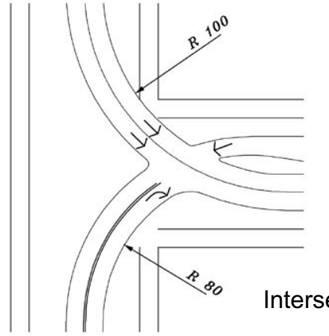
The backage roads would serve multiple purposes: they would handle the turning movements from FM 1960, they would provide access to parking, and they would enhance the shopping experience by creating a venue where community building can occur.

Traffic microsimulation was used to measure improvements attributable to the grade separation concept over existing conditions. While total distance traveled increased by 13 percent, total travel time decreased by 11 percent, average speed increased by 23 percent, and total network delay decreased by 20 percent. Improvements to FM 1960 alone were even more substantial. In contrast to the backage road concept, Kuykendahl Road experienced improvement in both travel directions under the Grade Separation Concept.

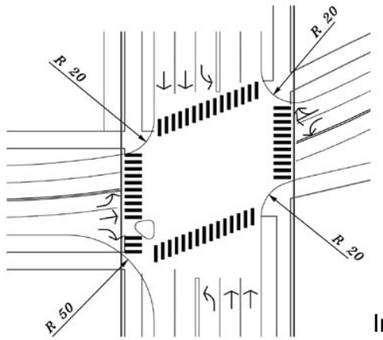
Grade separating the express street at a major intersection, in addition to shifting local access to backage roads, would result in substantial improvements to travel time, average speed, and traffic delay, thus improving the overall efficiency of the roadway network.



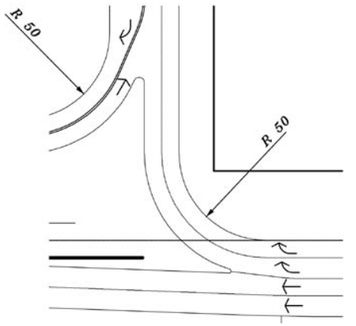
Intersection A



Intersection B



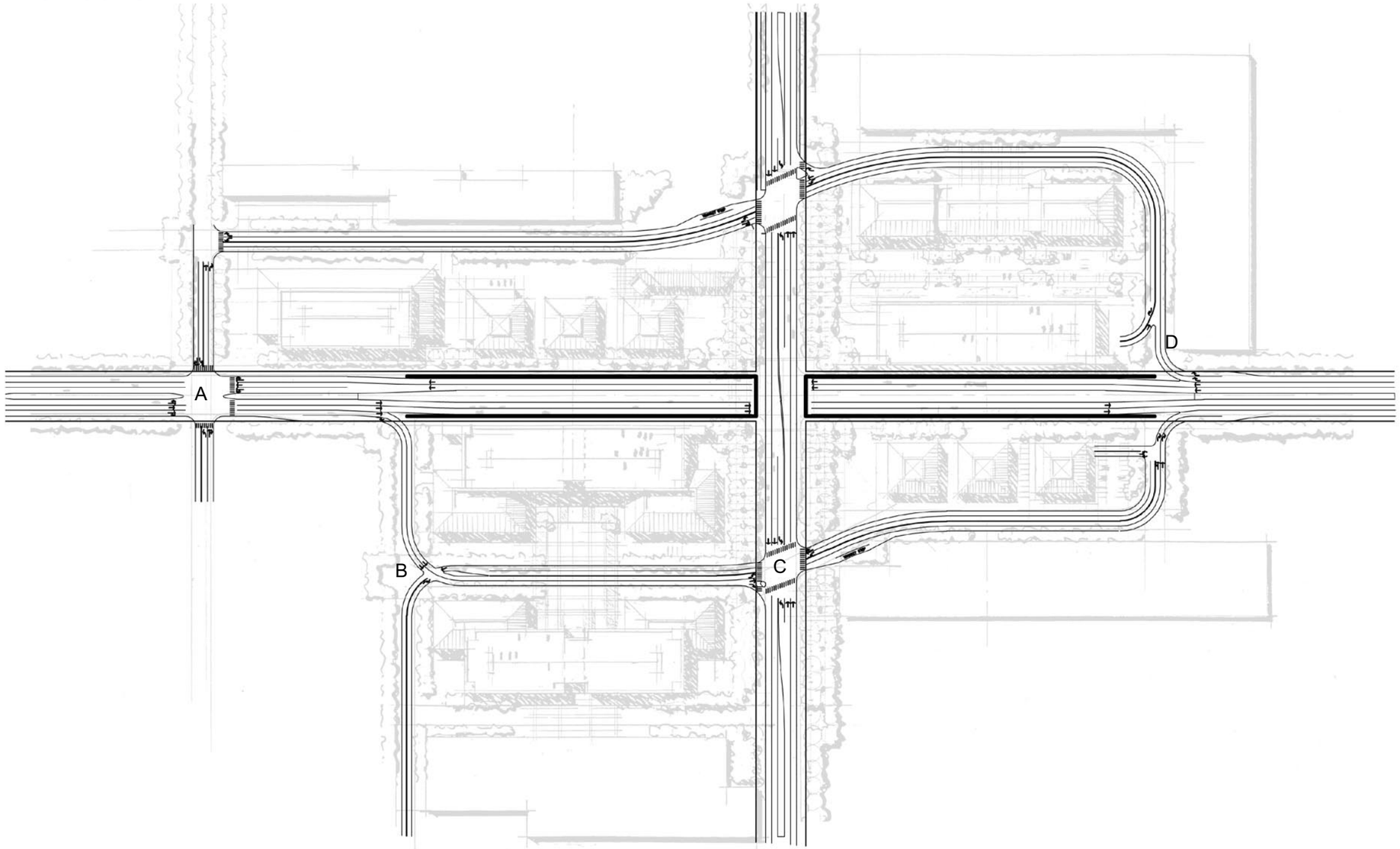
Intersection C



Intersection D

GRADE SEPARATION CONCEPT

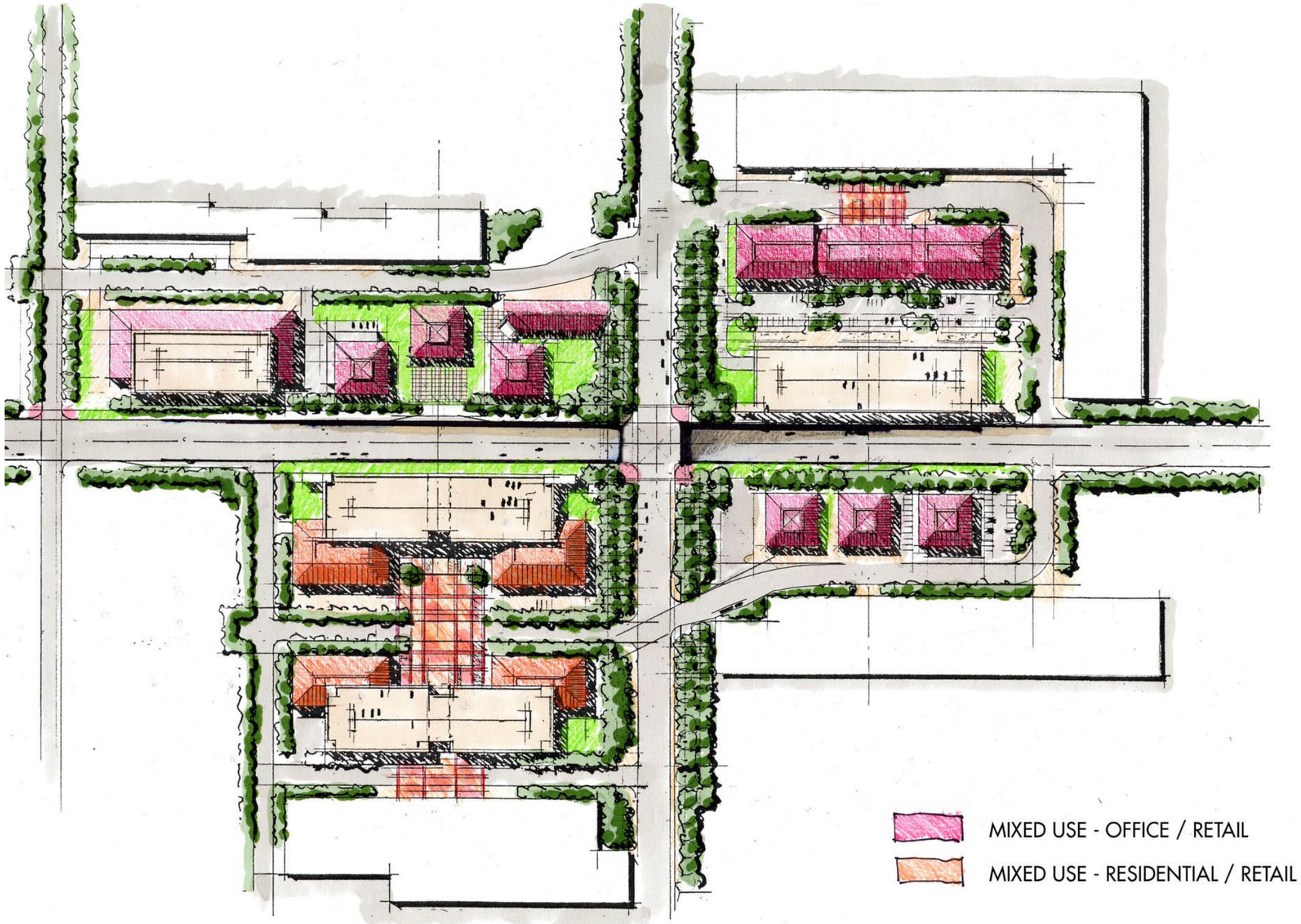
Transportation



GRADE SEPARATION CONCEPT

Development Prototype

The Grade Separation Concept would lead to the highest level of long-term redevelopment potential with the highest densities. Each level of transportation solution would increase the ability of the corridors to be supported by rapid transit, thus increasing the potential and need for redevelopment of key nodes into transit oriented villages.



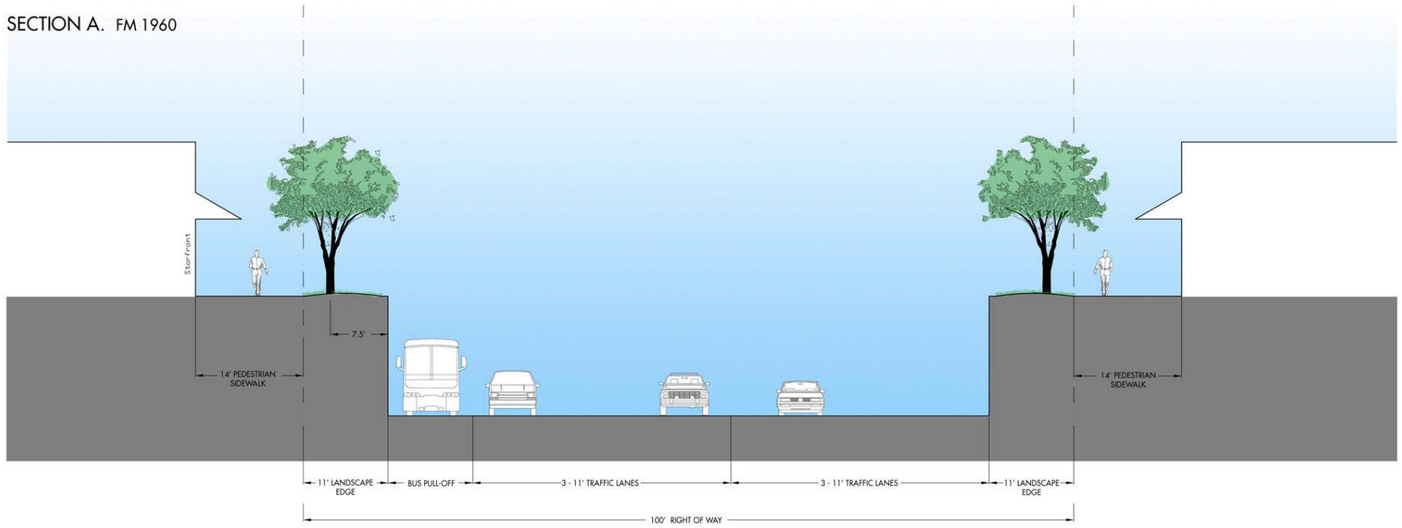
GRADE SEPARATION CONCEPT

Urban Design

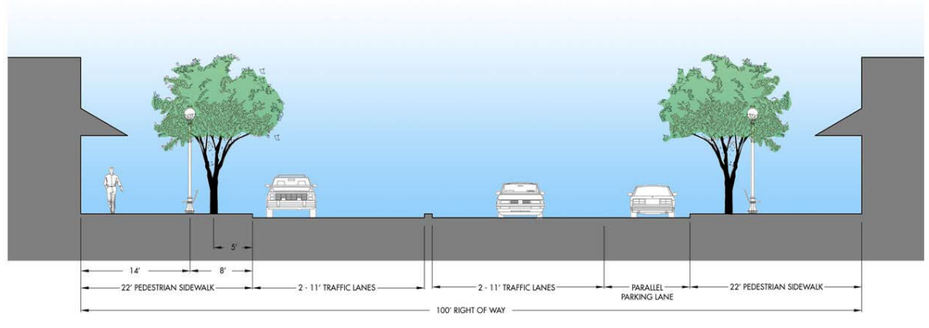
The primary artery would be framed with an 11-foot landscape edge with street tree planting concentrated towards the interior side. An ample 14-foot wide pedestrian sidewalk would front development, completing a connective visual aesthetic of development to the roadway environment. Minimal street furnishing amenities would be necessary along this frontage.

The backage road vicinity serves as the primary access from parking and on-street connection into new and existing development oriented inward towards the backage road circulator. Continuous sidewalk connections from adjacent development to the backage roadway curb create a pedestrian promenade with ample street furnishings such as benches, trash cans, pedestrian-scaled lighting, and street trees.

SECTION A. FM 1960



SECTION B. BACKAGE ROAD



GRADE SEPARATION WITH HIGH CAPACITY TRANSIT

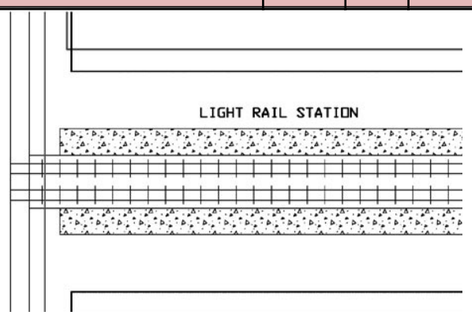
The last of the prototype alternative concepts is an enhancement to the grade separation concept. In certain corridors in Houston, high capacity transit such as light rail, monorail, or bus rapid transit is viable and highly desired. This concept is an exploration of adding high capacity transit to the corridor.

Transportation

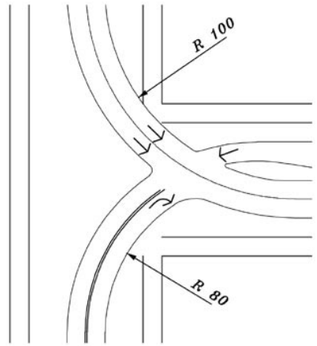
The function of this concept from a vehicular or pedestrian standpoint would be nearly identical to the grade separation concept and will therefore not be repeated. The one change would be that the transitway crosses Kuykendahl Road at grade, requiring either a traffic signal or crossing gates. This control device would stop traffic on Kuykendahl for a short duration at the frequency of transit operations.

The transit stop would be located on a deck spanning FM 1960 near Kuykendahl Road. With high capacity transit, the level of amenities would be expected to be much greater than with conventional bus service. Shade canopies, wind screens, ticket machines, information kiosks, and public art would all be integrated into the transit stops.

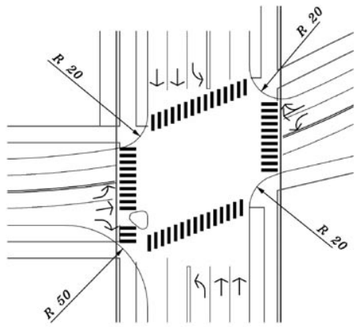
Conceptual Cost Estimates				
High Capacity Transit Concept				
Item	**Qty**	**Units**	**Unit Cost**	**Ext Cost**
Bridge	35000	SF	$100	$3,500,000
Retaining Wall	62500	SF	$35	$2,188,000
Rebuild roadway in underpass	2500	LF	$500	$1,250,000
Excavation	116000	CY	$10	$1,160,000
Right turn lanes	2	EA	$40,000	$80,000
New signals	2	EA	$100,000	$200,000
Signal interconnect	3300	LF	$40	$132,000
Railroad grade crossing protection	1	EA	$250,000	$ 250,000
LRT Guideway, including station	2500	LF	$5,000	$12,500,000
Driveways	15	EA	$2,000	$ 30,000
Backage roads	4400	LF	$400	$1,760,000
New sidewalks	8000	SY	$40	$ 320,000
Fencing	5000	LF	$20	$100,000
Undergrounding utilities	3300	LF	$100	$ 330,000
Street trees	100	EA	$250	$ 25,000
Bus pullouts	2	EA	$20,000	$40,000
Traffic Control	36	MO	$50,000	$1,800,000
Utility relocation	1	LS	$500,000	$500,000
ROW acquisition	0.5	AC	$1,000,000	$500,000
				$ -
TOTAL				$26.7 Million



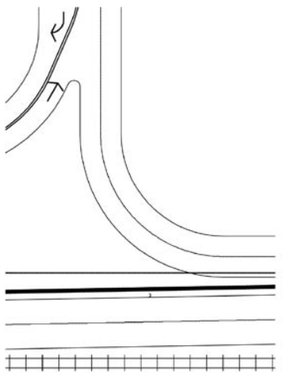
Intersection A



Intersection B



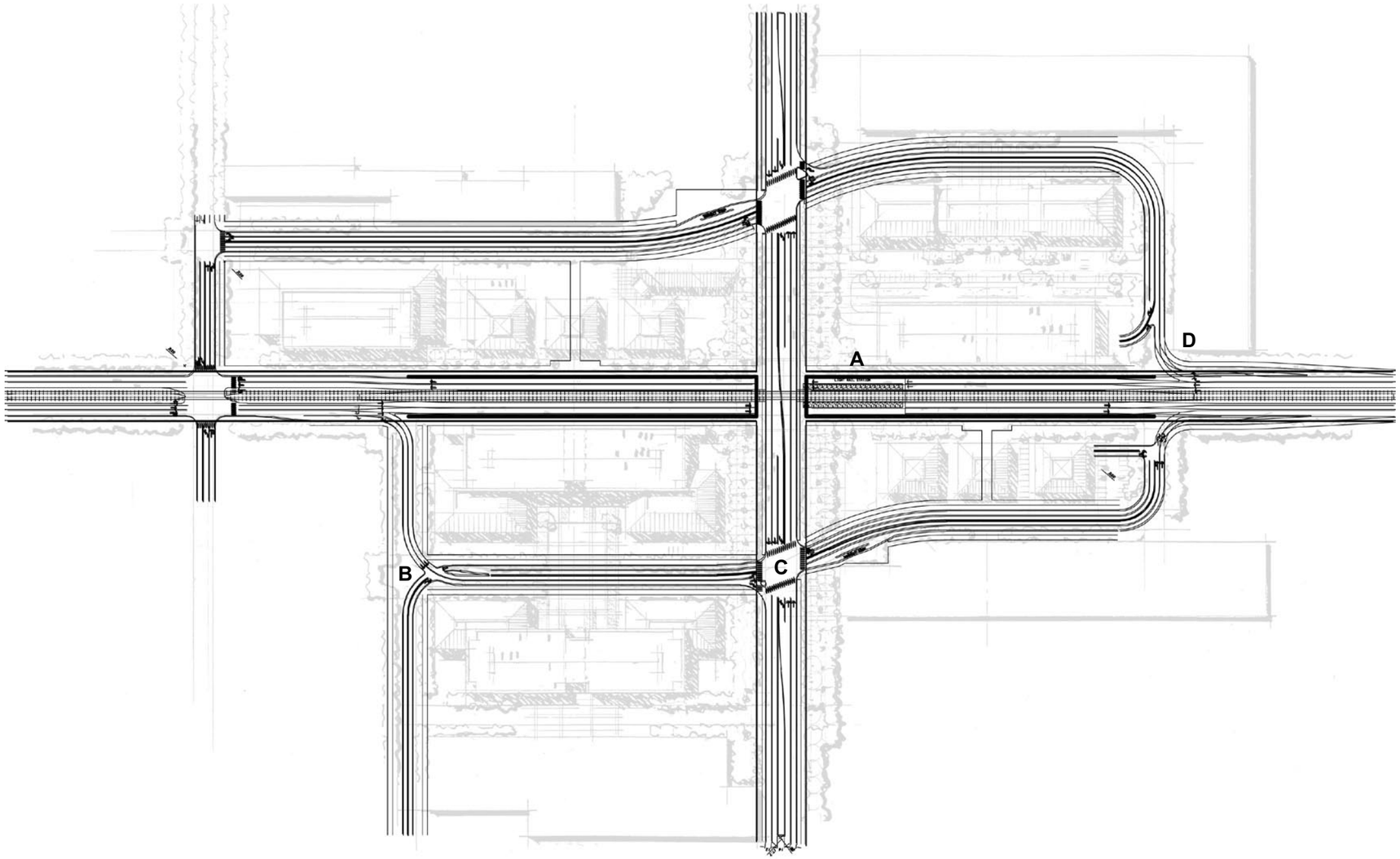
Intersection C



Intersection D

GRADE SEPARATION WITH HIGH CAPACITY TRANSIT

TRANSPORTATION



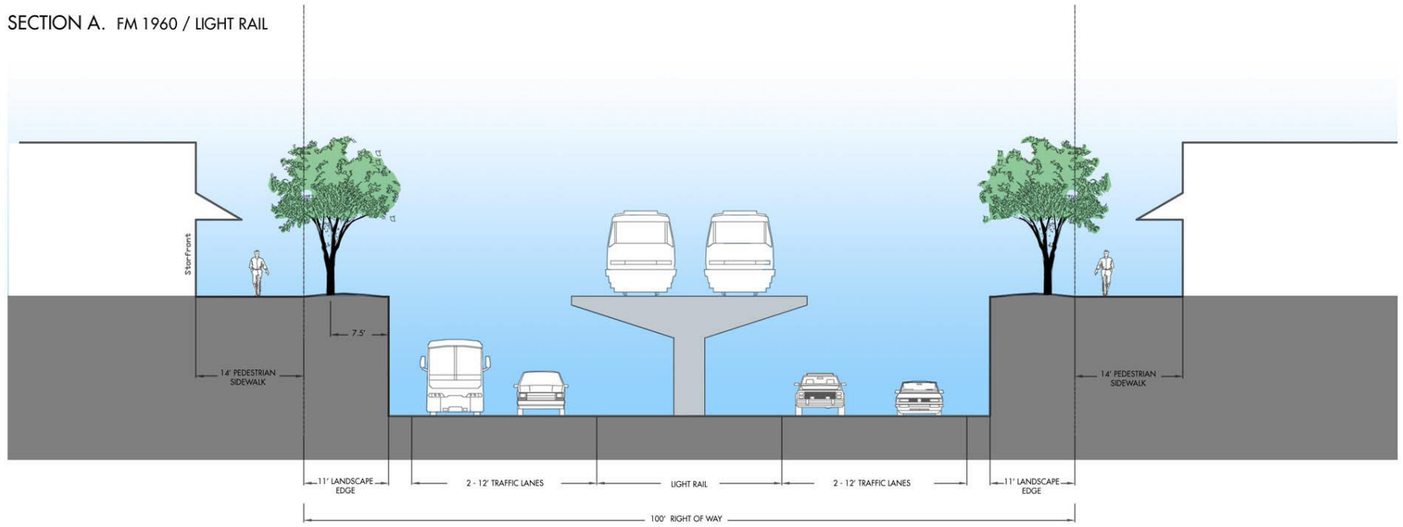
GRADE SEPARATION WITH HIGH CAPACITY TRANSIT

Urban Design

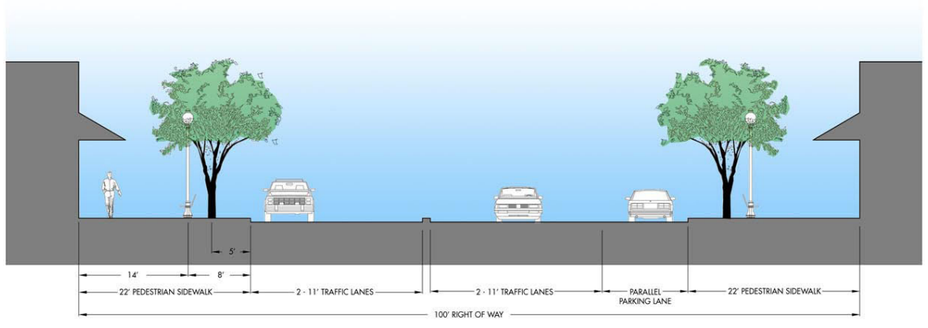
The primary artery would be framed with an 11-foot landscape edge with street tree planting concentrated towards the interior side. An ample 14-foot wide pedestrian sidewalk would front development, completing a connective visual aesthetic of development to the roadway environment. Minimal street furnishing amenities would be necessary along this frontage.

The backage road vicinity serves as the primary access from parking into new and existing development oriented towards the backage road circulator. Continuous sidewalk connections from adjacent development to the backage roadway curb create a pedestrian promenade with ample street furnishings including benches, trash cans, pedestrian-scaled lighting and street trees.

SECTION A. FM 1960 / LIGHT RAIL



SECTION B. BACKAGE ROAD



APPENDIX A

DETAILED COST ESTIMATES

Cost Estimates

				FACILITY AGENCY	FM 1960 TxDOT																											
					A1 - REMOVE TRAFFIC SIGNAL				A2 - MODIFY TRAFFIC SIGNAL				A3 - USE SINGLE SIGNAL CONTROLLER				B1 - MEDIAN CLOSURE				B2 - LEFT TURN LANE EXTENSION				B3, B4, C3 - RAISED MEDIANS				C1 - ADD RIGHT TURN LANE			
ITEM	CODE	DESCRIPTION	UNIT	PRICE	LOW QTY.	LOW COST	HIGH QTY.	HIGH COST	LOW QTY.	LOW COST	HIGH QTY.	HIGH COST	LOW QTY.	LOW COST	HIGH QTY.	HIGH COST	LOW QTY.	LOW COST	HIGH QTY.	HIGH COST	LOW QTY.	LOW COST	HIGH QTY.	HIGH COST	LOW QTY.	LOW COST	HIGH QTY.	HIGH COST	LOW QTY.	LOW COST	HIGH QTY.	HIGH COST
104	501	REMOV CONC (PAV)	SY	$ 6.50		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
104	503	REMOV CONC (RIPRAP)	SY	$ 7.25		$ -		$ -		$ -		$ -		$ -		$ -	8.00	$ 58.00	12.00	$ 87.00		$ -		$ -		$ -		$ -		$ -	2.00	$ 14.50	10.00	$ 72.50
104	514	REMOV CONC (CURB)	LF	$ 4.00		$ -		$ -		$ -		$ -		$ -		$ -	150.00	$ 600.00	250.00	$ 1,000.00	225.00	$ 900.00	258.75	$ 1,035.00	8100	$ 32,400.00	9315	$ 37,260.00	250.00	$ 1,000.00	312.50	$ 1,250.00
104	531	REMOV (WHEELCHAIR RAMP)	EA	$ 160.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	1.00	$ 160.00	2.00	$ 320.00
110	501	EXCAVATION	CY	$ 4.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	70.00	$ 280.00	80.50	$ 322.00	150	$ 600.00	172.5	$ 690.00	130.00	$ 520.00	162.50	$ 650.00
160	503	FURN AND PLACE TOPSOIL	CY	$ 6.00		$ -		$ -		$ -		$ -		$ -		$ -	35.00	$ 210.00	42.00	$ 252.00	25.00	$ 150.00	28.75	$ 172.50		$ -		$ -	85.00	$ 510.00	106.25	$ 637.50
162	505	MULCH SODDING	SY	$ 1.35		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
166	502	FERTILIZER (20-10-10)	TON	$ 200.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
192	502	BEDDING PLANTS (4" POT)	EA	$ 1.75		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
260	505	LIME TREAT SUBGR (DC) (6")	SY	$ 1.55		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	140.00	$ 217.00	161.00	$ 249.55		$ -		$ -	260.00	$ 403.00	325.00	$ 503.75
276	526	CEM TRT BS (STR-O) TY (D1 OR D2) (GR 6) 6"	SY	$ 6.35		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	140.00	$ 889.00	161.00	$ 1,022.35		$ -		$ -	260.00	$ 1,651.00	325.00	$ 2,063.75
360	505	CONC PAV (CONT REINF HY STL) (10)	SY	$ 60.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	140.00	$ 8,400.00	161.00	$ 9,660.00		$ -		$ -	260.00	$ 15,600.00	325.00	$ 19,500.00
360	509	MONO CURB (6")	LF	$ 2.35		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	50.00	$ 117.50	57.50	$ 135.13		$ -		$ -	100.00	$ 235.00	125.00	$ 293.75
432	501	RIPRAP (CONC) (CL B)	CY	$ 250.00		$ -		$ -		$ -		$ -		$ -		$ -	16.00	$ 4,000.00	24.00	$ 6,000.00		$ -		$ -	3460	$ 865,000.00	3979	$ 994,750.00	2.00	$ 500.00	10.00	$ 2,500.00
465	559	MANH (COMPL) (TY M) (MOD)	EA	$ 4,750.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	2.00	$ 9,500.00
479	501	ADJUST MANHOLE	EA	$ 1,500.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -	1.00	$ 1,500.00	1.00	$ 1,500.00	1.00	$ 1,500.00		$ -		$ -	1.00	$ 1,500.00	1.00	$ 1,500.00
529	505	CONC CURB (DOWEL) (6")	LF	$ 6.30		$ -		$ -		$ -		$ -		$ -		$ -	200.00	$ 1,260.00	350.00	$ 2,205.00	225.00	$ 1,417.50	258.75	$ 1,630.13	81600	$ 514,080.00	93840	$ 591,192.00	260.00	$ 1,638.00	325.00	$ 2,047.50
531	502	CONCRETE SIDEWALKS	SY	$ 36.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
531	503	CONCRETE SIDEWALK (WHEELCHAIR RAMP)	SY	$ 100.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
666	506	REFL PAV MRK TY I (W) (8") (SLD)	LF	$ 1.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	120.00	$ 120.00	138.00	$ 138.00	21500	$ 21,500.00	24725	$ 24,725.00	100.00	$ 100.00	125.00	$ 125.00
666	509	REFL PAV MRK TY I (W) (12") (SLD)	LF	$ 3.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	100.00	$ 300.00	125.00	$ 375.00
666	512	REFL PAV MRK TY I (W) (24") (SLD)	LF	$ 5.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	2150	$ 10,750.00	2472.5	$ 12,362.50	12.00	$ 60.00	15.00	$ 75.00
666	513	REFL PAV MRK TY I (W) (ARROW)	EA	$ 150.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	1.00	$ 150.00	1.00	$ 150.00	165	$ 24,750.00	190	$ 28,500.00	1.00	$ 150.00	2.00	$ 300.00
666	517	REFL PAV MRK TY I (W) (ONLY)	EA	$ 200.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	1.00	$ 200.00	1.00	$ 200.00	165	$ 33,000.00	190	$ 38,000.00	1.00	$ 200.00	2.00	$ 400.00
666	533	REFL PAV MRK TY I (Y) (ISLAND)	SF	$ 2.25		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	81600	$ 183,600.00	93840	$ 211,140.00		$ -		$ -
666	502	REFL PAV MRK TY I (W) (4") (BRK)	LF	$ 1.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	225.00	$ 225.00	258.75	$ 258.75	150400	$ 150,400.00	172960	$ 172,960.00	260.00	$ 260.00	325.00	$ 325.00
672	539	RAIS PAV MRK CL B (REFL) TY I-C (HV)	EA	$ 5.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	40.00	$ 200.00	46.00	$ 230.00	2150	$ 10,750.00	2475	$ 12,375.00	40.00	$ 200.00	50.00	$ 250.00
677	501	ELIM EXT PAV MRK & MRKR (4")	LF	$ 0.35		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	263200	$ 92,120.00	302680	$ 105,938.00		$ -		$ -
677	503	ELIM EXT PAV MRK & MRKR (8")	LF	$ 0.70		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
677	507	ELIM EXT PAV MRK ARROW	EA	$ 35.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	45	$ 1,575.00	51.75	$ 1,811.25		$ -		$ -
677	508	ELIM EXT PAV MRK WORD	EA	$ 35.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	45	$ 1,575.00	51.75	$ 1,811.25		$ -		$ -
678	503	PAV SURF PREP FOR MRKS (8")	LF	$ 0.10		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	120.00	$ 12.00	138.00	$ 13.80	21500	$ 2,150.00	24725	$ 2,472.50	100.00	$ 10.00	125.00	$ 12.50
678	504	PAV SURF PREP FOR MRKS (12")	LF	$ 0.35		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	100.00	$ 35.00	125.00	$ 43.75
678	506	PAV SURF PREP FOR MRKS (24")	LF	$ 0.55		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	2150	$ 1,182.50	2472.5	$ 1,359.88	12.00	$ 6.60	15.00	$ 8.25
678	507	PAV SURF PREP FOR MRKS (ARROW)	EA	$ 6.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	1.00	$ 6.00	1.00	$ 6.00	165	$ 990.00	189.75	$ 1,138.50	1.00	$ 6.00	2.00	$ 12.00
678	508	PAV SURF PREP FOR MRKS (ONLY)	EA	$ 6.50		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	1.00	$ 6.50	1.00	$ 6.50	165	$ 1,072.50	189.75	$ 1,233.38	1.00	$ 6.50	2.00	$ 13.00
618	516	CONDUIT (PVC) (SCHD 80) (1 1/4")	LF	$ 5.50		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
618	518	CONDUIT (PVC) (SCHD 80) (2")	LF	$ 7.00		$ -		$ -		$ -		$ -		$ -	1000.00	$ 7,000.00	1150.00	$ 8,050.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
620	504	ELEC CONDUCTOR (NO. 6) BARE	LF	$ 0.70		$ -		$ -		$ -		$ -		$ -	1000.00	$ 700.00	1150.00	$ 805.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
620		ELEC CONDUCTOR (NO. 8) INSULATED	LF	$ 0.80		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
624	504	GROUND BOX TY D (162922) W/APRON	EA	$ 600.00		$ -		$ -		$ -		$ -		$ -	4.00	$ 2,400.00	6.00	$ 3,600.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
624	512	GROUND BOX TY 2	EA	$ 850.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
628	655	ELEC SERV TYD(120/240)070(NS)SS(E)SP(O)	EA	$ 2,950.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
636	501	ALUM SIGNS (TY A)	SF	$ 16.50		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
644	638	SM RD ASSM TY S80 (1) SA (U-BM)	EA	$ 600.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
644	501	SMALL SIGN RDSD SGN ASSM (TY A)	EA	$ 500.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -	2.00	$ 1,000.00	2.00	$ 1,000.00	1.00	$ 500.00	1.00	$ 500.00	174	$ 87,000.00	200.1	$ 100,050.00	2.00	$ 1,000.00	4.00	$ 2,000.00
649	502	REMOV AND RELOC SMALL RDSD SGN ASSM	EA	$ 500.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
649	504	REMOV SMALL RDSD SGN ASSM	EA	$ 55.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -	2.00	$ 110.00	2.00	$ 110.00	1.00	$ 55.00	1.00	$ 55.00		$ -		$ -	2.00	$ 110.00	4.00	$ 220.00
656	518	TRAF SIG CNTRL FND	CY	$ 1,250.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
656	542	FND FOR TRAF SIG (TY A) (36 IN DR SH)	LF	$ 150.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
656	543	FND FOR TRAF SIG (TY B) (36 IN DR SH)	LF	$ 150.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
680	502	INSTAL OF HWY TRAF SIG (SYSTEM)	EA	$ 11,400.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	1.00	$ 11,400.00	1.00	$ 11,400.00
682	502	VEH SIG SEC (12 IN)	EA	$ 165.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
682	510	BACK PLATE (4 SEC) (12 IN)	EA	$ 90.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
684	544	TRAF SIG CBL (TY A) (7 CONDR) (16 AWG)	LF	$ 0.75		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
684	570	TRAF SIG CBL (5 CONDR) (14 AWG)	LF	$ 1.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
688	511	VEH DETECT (SAWCUT)	LF	$ 5.80		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
688	501	PED DETECT (PUSH BTN)	EA	$ 150.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
1201	501	12 INCH LED TRAF SIGNAL LAMP (RED)	EA	$ 60.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
1201		11 INCH LED TRAF SIGNAL LAMP (YEL)	EA	$ 60.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
1201	504	12 INCH LED TRAF SIGNAL LAMP (YEL ARW)	EA	$ 60.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
1201		11 INCH LED TRAF SIGNAL LAMP (GRN)	EA	$ 60.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
1201	505	12 INCH LED TRAF SIGNAL LAMP (GRN ARW)	EA	$ 60.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
6031	506	COMMUN CABLE (25 PAIR) (22 AWG)	LF	$ 2.50		$ -		$ -		$ -		$ -		$ -	1000.00	$ 2,500.00	1150.00	$ 2,875.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
6519	501	DETECTOR UNIT	EA	$ 1,000.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
8230	501	LED PED SIG LAMP(SYMB)(2 IND/1 SEC)	EA	$ 250.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
8524	501	PED POLE ASSEM	EA	$ 2,500.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
8970	501	VIVDS PROCESSOR SYSTEM	EA	$ 2,900.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
8970	502	VIVDS CAMERA ASSEMBLY	EA	$ 1,600.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
8970	503	VIVDS SET UP SYSTEM	EA	$ 900.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
8970	505	VIVDS COMMUNICATION CABLE (COAXIAL)	LF	$ 0.85		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
6010	501	SALV TRAFFIC SIGNALS	EA	$ 2,700.00	4.00	$ 10,800.00	4.00	$ 10,800.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
		ADJUST DRAINAGE	LS	$ 15,000.00						$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	1.00	$ 15,000.00	1.50	$ 22,500.00
502	501	BARRICADES SIGNS AND TRAF HANDLE	MO	$3,500.00	0.50	$ 1,750.00	1.00	$ 3,500.00		$ -		$ -	0.50	$ 1,750.00	1.00	$ 3,500.00	0.50	$ 1,750.00	2.00	$ 7,000.00	1.00	$ 3,500.00	2.00	$ 7,000.00	6	$ 21,000.00	12	$ 42,000.00	1.00	$ 3,500.00	2.00	$ 7,000.00
		SUB TOTAL 1				$ 12,550.00		$ 14,300.00		$ 2,146.34		$ 2,762.74		$ 14,350.00		$ 18,830.00		$ 8,988.00		$ 19,154.00		$ 18,845.50		$ 24,284.70		$ 2,055,495.00		$ 2,381,769.25		$ 56,075.60		$ 85,898.25
XXX	XXX	BONDS	LS	5%		$ 627.50		$ 715.00		$ 107.32		$ 138.14		$ 717.50		$ 941.50		$ 449.40		$ 957.70		$ 942.28		$ 1,214.24		$ 102,774.75		$ 119,088.46		$ 2,803.78		$ 4,294.91
500	501	MOBILIZATION	LS	20%		$ 2,510.00		$ 2,860.00		$ 429.27		$ 552.55		$ 2,870.00		$ 3,766.00		$ 1,797.60		$ 3,830.80		$ 3,769.10		$ 4,856.94		$ 411,099.00		$ 476,353.85		$ 11,215.12		$ 17,179.65
		SUB TOTAL 2				$ 15,687.50		$ 17,875.00		$ 2,682.92		$ 3,453.42		$ 17,937.50		$ 23,537.50		$ 11,235.00		$ 23,942.50		$ 23,556.88		$ 30,355.88		$ 2,569,368.75		$ 2,977,211.56		$ 70,094.50		$ 107,372.81
XXX	XXX	MISCELLANEOUS & CONTINGENCY	LS	20%		$ 3,137.50		$ 3,575.00		$ 536.58		$ 690.68		$ 3,587.50		$ 4,707.50		$ 2,247.00		$ 4,788.50		$ 4,711.38		$ 6,071.18		$ 513,873.75		$ 595,442.31		$ 14,018.90		$ 21,474.56
		GRAND TOTAL				$ 18,825.00		$ 21,450.00		$ 3,219.51		$ 4,144.11		$ 21,525.00		$ 28,245.00		$ 13,482.00		$ 28,731.00		$ 28,268.25		$ 36,427.05		$ 3,083,242.50		$ 3,572,653.88		$ 84,113.40		$ 128,847.38
		CALLED				**$ 18,900.00**		**$ 21,500.00**		**$ 3,300.00**		**$ 4,200.00**		**$ 21,600.00**		**$ 28,300.00**		**$ 13,500.00**		**$ 28,800.00**		**$ 28,300.00**		**$ 36,500.00**		**$ 3,083,300.00**		**$ 3,572,700.00**		**$ 84,200.00**		**$ 128,900.00**
		AVERAGE UNIT COST (ROUNDED TO NEAREST $100)						**$ 20,200.00**				**$ 3,800.00**				**$ 25,000.00**				**$ 21,200.00**				**$ 32,400.00**				**$ 3,328,000.00**				**$ 106,600.00**

Note: Miscellaneous items include Engineering Design Fee, Survey and Material Testing.

					FACILITY AGENCY	FM 1960 TxDOT																									
						C2 - RIGHT TURN LANE EXTENSION				C5 - CONVERT THRU LANE TO TURN LANE				C6 - PROHIBIT LEFT TURN MOVEMENT				C7 - ADD SIDEWALKS				E1 - MINOR DRIVEWAY MODIFICATION				E2 - MAJOR DRIVEWAY MODIFICATION			
ITEM	CODE	DESCRIPTION	UNIT	PRICE	LOW QTY.	LOW COST	HIGH QTY.	HIGH COST	LOW QTY.	LOW COST	HIGH QTY.	HIGH COST	LOW QTY.	LOW COST	HIGH QTY.	HIGH COST	LOW QTY.	LOW COST	HIGH QTY.	HIGH COST	LOW QTY.	LOW COST	HIGH QTY.	HIGH COST	LOW QTY.	LOW COST	HIGH QTY.	HIGH COST
104	501	REMOV CONC (PAV)	SY	$ 6.50		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	100.00	$ 650.00	200.00	$ 1,300.00	50.00	$ 325.00	70.00	$ 455.00
104	503	REMOV CONC (RIPRAP)	SY	$ 7.25		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	10.00	$ 72.50	14.00	$ 101.50
104	514	REMOV CONC (CURB)	LF	$ 4.00	225.00	$ 900.00	258.75	$ 1,035.00		$ -		$ -	300.00	$ 1,200.00	375.00	$ 1,500.00		$ -		$ -	65.00	$ 260.00	130.00	$ 520.00	80.00	$ 320.00	112.00	$ 448.00
104	531	REMOV (WHEELCHAIR RAMP)	EA	$ 160.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	2.00	$ 320.00	2.00	$ 320.00	2.00	$ 320.00	2.00	$ 320.00
110	501	EXCAVATION	CY	$ 4.00	70.00	$ 280.00	80.50	$ 322.00		$ -		$ -		$ -		$ -	33.33	$ 133.33	66.67	$ 266.67		$ -		$ -	15.00	$ 60.00	21.00	$ 84.00
160	503	FURN AND PLACE TOPSOIL	CY	$ 6.00	25.00	$ 150.00	28.75	$ 172.50		$ -		$ -		$ -		$ -		$ -		$ -	10.00	$ 60.00	20.00	$ 120.00	10.00	$ 60.00	14.00	$ 84.00
162	505	MULCH SODDING	SY	$ 1.35		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
166	502	FERTILIZER (20-10-10)	TON	$ 200.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
192	502	BEDDING PLANTS (4" POT)	EA	$ 1.75		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
260	505	LIME TREAT SUBGR (DC) (6")	SY	$ 1.55	140.00	$ 217.00	161.00	$ 249.55		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	50.00	$ 77.50	70.00	$ 108.50
276	526	CEM TRT BS (STR-O) TY (D1 OR D2) (GR 6) 6"	SY	$ 6.35	140.00	$ 889.00	161.00	$ 1,022.35		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	50.00	$ 317.50	70.00	$ 444.50
360	505	CONC PAV (CONT REINF HY STL) (10)	SY	$ 60.00	140.00	$ 8,400.00	161.00	$ 9,660.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	50.00	$ 3,000.00	70.00	$ 4,200.00
360	509	MONO CURB (6")	LF	$ 2.35	50.00	$ 117.50	57.50	$ 135.13		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
432	501	RIPRAP (CONC) (CL B)	CY	$ 250.00		$ -		$ -		$ -		$ -	55.33	$ 13,833.33	72.00	$ 18,000.00		$ -		$ -	1.00	$ 250.00	1.50	$ 375.00	2.50	$ 625.00	3.50	$ 875.00
465	559	MANH (COMPL) (TY M) (MOD)	EA	$ 4,750.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
479	501	ADJUST MANHOLE	EA	$ 1,500.00	1.00	$ 1,500.00	1.00	$ 1,500.00		$ -		$ -	1.00	$ 1,500.00	1.00	$ 1,500.00		$ -		$ -		$ -		$ -		$ -	1.00	$ 1,500.00
529	505	CONC CURB (DOWEL) (6")	LF	$ 6.30	225.00	$ 1,417.50	258.75	$ 1,630.13		$ -		$ -	300.00	$ 1,890.00	375.00	$ 2,362.50		$ -		$ -	65.00	$ 409.50	130.00	$ 819.00	120.00	$ 756.00	168.00	$ 1,058.40
531	502	CONCRETE SIDEWALKS	SY	$ 36.00		$ -		$ -		$ -		$ -		$ -		$ -	300.00	$ 10,800.00	600.00	$ 21,600.00		$ -		$ -	10.00	$ 360.00	14.00	$ 504.00
531	503	CONCRETE SIDEWALK (WHEELCHAIR RAMP)	SY	$ 100.00		$ -		$ -		$ -		$ -		$ -		$ -	5.00	$ 500.00	10.00	$ 1,000.00	2.00	$ 200.00	2.00	$ 200.00	2.00	$ 200.00	2.00	$ 200.00
666	506	REFL PAV MRK TY I (W) (8") (SLD)	LF	$ 1.00	120.00	$ 120.00	138.00	$ 138.00	200.00	$ 200.00	325.00	$ 325.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
666	509	REFL PAV MRK TY I (W) (12") (SLD)	LF	$ 3.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	50.00	$ 150.00	57.50	$ 172.50
666	512	REFL PAV MRK TY I (W) (24") (SLD)	LF	$ 5.00		$ -		$ -	11.00	$ 55.00	15.00	$ 75.00		$ -		$ -		$ -		$ -		$ -		$ -	20.00	$ 100.00	23.00	$ 115.00
666	513	REFL PAV MRK TY I (W) (ARROW)	EA	$ 150.00	1.00	$ 150.00	1.00	$ 150.00	1.00	$ 150.00	2.00	$ 300.00		$ -		$ -		$ -		$ -		$ -		$ -	1.00	$ 150.00	1.00	$ 150.00
666	517	REFL PAV MRK TY I (W) (ONLY)	EA	$ 200.00	1.00	$ 200.00	1.00	$ 200.00	1.00	$ 200.00	2.00	$ 400.00		$ -		$ -		$ -		$ -		$ -		$ -	1.00	$ 200.00	1.00	$ 200.00
666	533	REFL PAV MRK TY I (Y) (ISLAND)	SF	$ 2.25		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
666	502	REFL PAV MRK TY I (W) (4") (BRK)	LF	$ 1.00	225.00	$ 225.00	258.75	$ 258.75		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	140.00	$ 140.00	161.00	$ 161.00
672	539	RAIS PAV MRK CL B (REFL) TY I-C (HV)	EA	$ 5.00	40.00	$ 200.00	46.00	$ 230.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
677	501	ELIM EXT PAV MRK & MRKR (4")	LF	$ 0.35		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
677	503	ELIM EXT PAV MRK & MRKR (8")	LF	$ 0.70		$ -		$ -		$ -		$ -	150.00	$ 105.00	225.00	$ 157.50		$ -		$ -		$ -		$ -		$ -		$ -
677	507	ELIM EXT PAV MRK ARROW	EA	$ 35.00		$ -		$ -		$ -		$ -	1.00	$ 35.00	2.00	$ 70.00		$ -		$ -		$ -		$ -		$ -		$ -
677	508	ELIM EXT PAV MRK WORD	EA	$ 35.00		$ -		$ -		$ -		$ -	1.00	$ 35.00	2.00	$ 70.00		$ -		$ -		$ -		$ -		$ -		$ -
678	503	PAV SURF PREP FOR MRKS (8")	LF	$ 0.10	120.00	$ 12.00	138.00	$ 13.80	200.00	$ 20.00	325.00	$ 32.50		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
678	504	PAV SURF PREP FOR MRKS (12")	LF	$ 0.35		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	50.00	$ 17.50	57.50	$ 20.13
678	506	PAV SURF PREP FOR MRKS (24")	LF	$ 0.55		$ -		$ -	11.00	$ 6.05	15.00	$ 8.25		$ -		$ -		$ -		$ -		$ -		$ -	20.00	$ 11.00	23.00	$ 12.65
678	507	PAV SURF PREP FOR MRKS (ARROW)	EA	$ 6.00	1.00	$ 6.00	1.00	$ 6.00	1.00	$ 6.00	2.00	$ 12.00		$ -		$ -		$ -		$ -		$ -		$ -	1.00	$ 6.00	1.00	$ 6.00
678	508	PAV SURF PREP FOR MRKS (ONLY)	EA	$ 6.50	1.00	$ 6.50	1.00	$ 6.50	1.00	$ 6.50	2.00	$ 13.00		$ -		$ -		$ -		$ -		$ -		$ -	1.00	$ 6.50	1.00	$ 6.50
618	516	CONDUIT (PVC) (SCHD 80) (1 1/4")	LF	$ 5.50		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
618	518	CONDUIT (PVC) (SCHD 80) (2")	LF	$ 7.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
620	504	ELEC CONDUCTOR (NO. 6) BARE	LF	$ 0.70		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
620		ELEC CONDUCTOR (NO. 8) INSULATED	LF	$ 0.80		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
624	504	GROUND BOX TY D (162922) W/APRON	EA	$ 600.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
624	512	GROUND BOX TY 2	EA	$ 850.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
628	655	ELEC SERV TYD(120/240)070(NS)SS(E)SP(O)	EA	$ 2,950.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
636	501	ALUM SIGNS (TY A)	SF	$ 16.50		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
644	638	SM RD ASSM TY S80 (1) SA (U-BM)	EA	$ 600.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
644	501	SMALL SIGN RDSD SGN ASSM (TY A)	EA	$ 500.00	1.00	$ 500.00	1.00	$ 500.00	3.00	$ 1,500.00	4.00	$ 2,000.00		$ -		$ -		$ -		$ -		$ -		$ -	1.00	$ 500.00	2.00	$ 1,000.00
649	502	REMOV AND RELOC SMALL RDSD SGN ASSM	EA	$ 500.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
649	504	REMOV SMALL RDSD SGN ASSM	EA	$ 55.00	1.00	$ 55.00	1.00	$ 55.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	1.00	$ 55.00	2.00	$ 110.00
656	518	TRAF SIG CNTRL FND	CY	$ 1,250.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
656	542	FND FOR TRAF SIG (TY A) (36 IN DR SH)	LF	$ 150.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
656	543	FND FOR TRAF SIG (TY B) (36 IN DR SH)	LF	$ 150.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
680	502	INSTAL OF HWY TRAF SIG (SYSTEM)	EA	$ 11,400.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
682	502	VEH SIG SEC (12 IN)	EA	$ 165.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
682	510	BACK PLATE (4 SEC) (12 IN)	EA	$ 90.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
684	544	TRAF SIG CBL (TY A) (7 CONDR) (16 AWG)	LF	$ 0.75		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
684	570	TRAF SIG CBL (5 CONDR) (14 AWG)	LF	$ 1.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
688	511	VEH DETECT (SAWCUT)	LF	$ 5.80		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
688	501	PED DETECT (PUSH BTN)	EA	$ 150.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
1201	501	12 INCH LED TRAF SIGNAL LAMP (RED)	EA	$ 60.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
1201		11 INCH LED TRAF SIGNAL LAMP (YEL)	EA	$ 60.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
1201	504	12 INCH LED TRAF SIGNAL LAMP (YEL ARW)	EA	$ 60.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
1201		11 INCH LED TRAF SIGNAL LAMP (GRN)	EA	$ 60.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
1201	505	12 INCH LED TRAF SIGNAL LAMP (GRN ARW)	EA	$ 60.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
6031	506	COMMUN CABLE (25 PAIR) (22 AWG)	LF	$ 2.50		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
6519	501	DETECTOR UNIT	EA	$ 1,000.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
8230	501	LED PED SIG LAMP(SYMB)(2 IND/1 SEC)	EA	$ 250.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
8524	501	PED POLE ASSEM	EA	$ 2,500.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
8970	501	VIVDS PROCESSOR SYSTEM	EA	$ 2,900.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
8970	502	VIVDS CAMERA ASSEMBLY	EA	$ 1,600.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
8970	503	VIVDS SET UP SYSTEM	EA	$ 900.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
8970	505	VIVDS COMMUNICATION CABLE (COAXIAL)	LF	$ 0.85		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
6010	501	SALV TRAFFIC SIGNALS	EA	$ 2,700.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
		ADJUST DRAINAGE	LS	$ 15,000.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
502	501	BARRICADES SIGNS AND TRAF HANDLE	MO	$3,500.00	1.00	$ 3,500.00	2.00	$ 7,000.00	0.50	$ 1,750.00	1.00	$ 3,500.00	0.50	$ 1,750.00	1.00	$ 3,500.00	1.00	$ 3,500.00	2.00	$ 7,000.00	0.50	$ 1,750.00	1.00	$ 3,500.00	1.00	$ 3,500.00	1.50	$ 5,250.00
		SUB TOTAL 1				$ 18,845.50		$ 24,284.70		$ 3,893.55		$ 6,665.75		$ 20,348.33		$ 27,160.00		$ 14,933.33		$ 29,866.67		$ 3,899.50		$ 7,154.00		$ 11,329.50		$ 17,586.68
XXX	XXX	BONDS	LS	5%		$ 942.28		$ 1,214.24		$ 194.68		$ 333.29		$ 1,017.42		$ 1,358.00		$ 746.67		$ 1,493.33		$ 194.98		$ 357.70		$ 566.48		$ 879.33
500	501	MOBILIZATION	LS	20%		$ 3,769.10		$ 4,856.94		$ 778.71		$ 1,333.15		$ 4,069.67		$ 5,432.00		$ 2,986.67		$ 5,973.33		$ 779.90		$ 1,430.80		$ 2,265.90		$ 3,517.34
		SUB TOTAL 2				$ 23,556.88		$ 30,355.88		$ 4,866.94		$ 8,332.19		$ 25,435.42		$ 33,950.00		$ 18,666.67		$ 37,333.33		$ 4,874.38		$ 8,942.50		$ 14,161.88		$ 21,983.34
XXX	XXX	MISCELLANEOUS & CONTINGENCY	LS	20%		$ 4,711.38		$ 6,071.18		$ 973.39		$ 1,666.44		$ 5,087.08		$ 6,790.00		$ 3,733.33		$ 7,466.67		$ 974.88		$ 1,788.50		$ 2,832.38		$ 4,396.67
		GRAND TOTAL				$ 28,268.25		$ 36,427.05		$ 5,840.33		$ 9,998.63		$ 30,522.50		$ 40,740.00		$ 22,400.00		$ 44,800.00		$ 5,849.25		$ 10,731.00		$ 16,994.25		$ 26,380.01
		CALLED				**$ 28,300.00**		**$ 36,500.00**		**$ 5,900.00**		**$ 10,000.00**		**$ 30,600.00**		**$ 40,800.00**		**$ 22,400.00**		**$ 44,800.00**		**$ 5,900.00**		**$ 10,800.00**		**$ 17,000.00**		**$ 26,400.00**
		AVERAGE UNIT COST (ROUNDED TO NEAREST $100)						**$ 32,400.00**				**$ 8,000.00**				**$ 35,700.00**				**$ 33,600.00**				**$ 8,400.00**				**$ 21,700.00**

Note: Miscellaneous items include Engineering Design Fee, Survey and Material Testing.

Cost Estimates

				FACILITY AGENCY	FM 1960 TxDOT																				CROSS STREETS HARRIS COUNTY							
					E3 - SHARED DRIVEWAY				H1 - ADJUST BUS STOP				H2 - SIDEWALK FROM BUS STOP				I1 - ADD GUIDE SIGN				I2 - ADD NO LEFT TURN SIGN				D1 - ADD DUAL LEFTS				D2 & D 3 - ADD LEFT OR RIGHT TURN LANE			
ITEM	CODE	DESCRIPTION	UNIT	PRICE	LOW QTY.	LOW COST	HIGH QTY.	HIGH COST	LOW QTY.	LOW COST	HIGH QTY.	HIGH COST	LOW QTY.	LOW COST	HIGH QTY.	HIGH COST	LOW QTY.	LOW COST	HIGH QTY.	HIGH COST	LOW QTY.	LOW COST	HIGH QTY.	HIGH COST	LOW QTY.	LOW COST	HIGH QTY.	HIGH COST	LOW QTY.	LOW COST	HIGH QTY.	HIGH COST
104	501	REMOV CONC (PAV)	SY	$ 6.50		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
104	503	REMOV CONC (RIPRAP)	SY	$ 7.25		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	1.00	$ 7.25	1.25	$ 9.06	1.00	$ 7.25	1.25	$ 9.06
104	514	REMOV CONC (CURB)	LF	$ 4.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	225.00	$ 900.00	281.25	$ 1,125.00	250.00	$ 1,000.00	312.50	$ 1,250.00
104	531	REMOV (WHEELCHAIR RAMP)	EA	$ 160.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	1.00	$ -	1.00	$ 160.00
110	501	EXCAVATION	CY	$ 4.00		$ -		$ -		$ -	5.00	$ 20.00	10.00	$ 40.00		$ -		$ -		$ -		$ -		$ -	112.50	$ 450.00	140.63	$ 562.52	130.00	$ 520.00	162.50	$ 650.00
160	503	FURN AND PLACE TOPSOIL	CY	$ 6.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	30.00	$ 180.00	37.50	$ 225.00	85.00	$ 510.00	106.25	$ 637.50
162	505	MULCH SODDING	SY	$ 1.35		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
166	502	FERTILIZER (20-10-10)	TON	$ 200.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
192	502	BEDDING PLANTS (4" POT)	EA	$ 1.75		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
260	505	LIME TREAT SUBGR (DC) (6")	SY	$ 1.55		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	225.00	$ 348.75	281.25	$ 435.94	260.00	$ 403.00	325.00	$ 503.75
276	526	CEM TRT BS (STR-O) TY (D1 OR D2) (GR 6) 6"	SY	$ 6.35		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	225.00	$ 1,428.75	281.25	$ 1,785.94	260.00	$ 1,651.00	325.00	$ 2,063.75
360	505	CONC PAV (CONT REINF HY STL) (10)	SY	$ 60.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	225.00	$ 13,500.00	281.25	$ 16,875.00	260.00	$ 15,600.00	325.00	$ 19,500.00
360	509	MONO CURB (6")	LF	$ 2.35		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	50.00	$ 117.50	62.50	$ 146.88	100.00	$ 235.00	125.00	$ 293.75
432	501	RIPRAP (CONC) (CL B)	CY	$ 250.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	0.25	$ 62.50	0.50	$ 125.00		$ -	1.00	$ 250.00	1.00	$ 250.00	1.25	$ 312.50
465	559	MANH (COMPL) (TY M) (MOD)	EA	$ 4,750.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	1.00	$ 4,750.00
479	501	ADJUST MANHOLE	EA	$ 1,500.00		$ -		$ -		$ -		$ -	1.00	$ 1,500.00		$ -		$ -		$ -		$ -		$ -	1.00	$ 1,500.00	2.00	$ 3,000.00	1.00	$ 1,500.00		$ -
529	505	CONC CURB (DOWEL) (6")	LF	$ 6.30		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	225.00	$ 1,417.50	281.25	$ 1,771.88	260.00	$ 1,638.00	325.00	$ 2,047.50
531	502	CONCRETE SIDEWALKS	SY	$ 36.00		$ -		$ -		$ -	45.00	$ 1,620.00	90.00	$ 3,240.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
531	503	CONCRETE SIDEWALK (WHEELCHAIR RAMP)	SY	$ 100.00		$ -		$ -		$ -	2.00	$ 200.00	4.00	$ 400.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
666	506	REFL PAV MRK TY I (W) (8") (SLD)	LF	$ 1.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	120.00	$ 120.00	150.00	$ 150.00	100.00	$ 100.00	125.00	$ 125.00
666	509	REFL PAV MRK TY I (W) (12") (SLD)	LF	$ 3.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	100.00	$ 300.00	125.00	$ 375.00
666	512	REFL PAV MRK TY I (W) (24") (SLD)	LF	$ 5.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	12.00	$ 60.00	15.00	$ 75.00
666	513	REFL PAV MRK TY I (W) (ARROW)	EA	$ 150.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	1.00	$ 150.00	1.00	$ 150.00	1.00	$ 150.00	2.00	$ 300.00
666	517	REFL PAV MRK TY I (W) (ONLY)	EA	$ 200.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	1.00	$ 200.00	1.00	$ 200.00	1.00	$ 200.00	2.00	$ 400.00
666	533	REFL PAV MRK TY I (Y) (ISLAND)	SF	$ 2.25		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
666	502	REFL PAV MRK TY I (W) (4") (BRK)	LF	$ 1.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	225.00	$ 225.00	281.25	$ 281.25	260.00	$ 260.00	325.00	$ 325.00
672	539	RAIS PAV MRK CL B (REFL) TY I-C (HV)	EA	$ 5.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	40.00	$ 200.00	50.00	$ 250.00	40.00	$ 200.00	50.00	$ 250.00
677	501	ELIM EXT PAV MRK & MRKR (4")	LF	$ 0.35		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
677	503	ELIM EXT PAV MRK & MRKR (8")	LF	$ 0.70		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
677	507	ELIM EXT PAV MRK ARROW	EA	$ 35.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
677	508	ELIM EXT PAV MRK WORD	EA	$ 35.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
678	503	PAV SURF PREP FOR MRKS (8")	LF	$ 0.10		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	120.00	$ 12.00	150.00	$ 15.00	100.00	$ 10.00	125.00	$ 12.50
678	504	PAV SURF PREP FOR MRKS (12")	LF	$ 0.35		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	100.00	$ 35.00	125.00	$ 43.75
678	506	PAV SURF PREP FOR MRKS (24")	LF	$ 0.55		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	12.00	$ 6.60	15.00	$ 8.25
678	507	PAV SURF PREP FOR MRKS (ARROW)	EA	$ 6.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	1.00	$ 6.00	1.00	$ 6.00	1.00	$ 6.00	2.00	$ 12.00
678	508	PAV SURF PREP FOR MRKS (ONLY)	EA	$ 6.50		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	1.00	$ 6.50	1.00	$ 6.50	1.00	$ 6.50	2.00	$ 13.00
618	516	CONDUIT (PVC) (SCHD 80) (1 1/4")	LF	$ 5.50		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
618	518	CONDUIT (PVC) (SCHD 80) (2")	LF	$ 7.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
620	504	ELEC CONDUCTOR (NO. 6) BARE	LF	$ 0.70		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
620		ELEC CONDUCTOR (NO. 8) INSULATED	LF	$ 0.80		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
624	504	GROUND BOX TY D (162922) W/APRON	EA	$ 600.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
624	512	GROUND BOX TY 2	EA	$ 850.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
628	655	ELEC SERV TYD(120/240)070(NS)SS(E)SP(O)	EA	$ 2,950.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
636	501	ALUM SIGNS (TY A)	SF	$ 16.50		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -	15.00	$ 247.50	30.00	$ 495.00		$ -		$ -		$ -		$ -		$ -
644	638	SM RD ASSM TY S80 (1) SA (U-BM)	EA	$ 600.00		$ -		$ -		$ -		$ -		$ -		$ -	1.00	$ 600.00	2.00	$ 1,200.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -
644	501	SMALL SIGN RDSD SGN ASSM (TY A)	EA	$ 500.00		$ -		$ -	1.00	$ 500.00	1.00	$ 500.00		$ -		$ -		$ -		$ -	1.00	$ 500.00	1.00	$ 500.00	2.00	$ 1,000.00	4.00	$ 2,000.00	2.00	$ 1,000.00	4.00	$ 2,000.00
649	502	REMOV AND RELOC SMALL RDSD SGN ASSM	EA	$ 500.00		$ -		$ -		$ -	2.00	$ 1,000.00	3.00	$ 1,500.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
649	504	REMOV SMALL RDSD SGN ASSM	EA	$ 55.00		$ -	1.00	$ 55.00	1.00	$ 55.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -	2.00	$ 110.00	4.00	$ 220.00	2.00	$ 110.00	4.00	$ 220.00
656	518	TRAF SIG CNTRL FND	CY	$ 1,250.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
656	542	FND FOR TRAF SIG (TY A) (36 IN DR SH)	LF	$ 150.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
656	543	FND FOR TRAF SIG (TY B) (36 IN DR SH)	LF	$ 150.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
680	502	INSTAL OF HWY TRAF SIG (SYSTEM)	EA	$ 11,400.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
682	502	VEH SIG SEC (12 IN)	EA	$ 165.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
682	510	BACK PLATE (4 SEC) (12 IN)	EA	$ 90.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
684	544	TRAF SIG CBL (TY A) (7 CONDR) (16 AWG)	LF	$ 0.75		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
684	570	TRAF SIG CBL (5 CONDR) (14 AWG)	LF	$ 1.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
688	511	VEH DETECT (SAWCUT)	LF	$ 5.80		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
688	501	PED DETECT (PUSH BTN)	EA	$ 150.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
1201	501	12 INCH LED TRAF SIGNAL LAMP (RED)	EA	$ 60.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
1201		11 INCH LED TRAF SIGNAL LAMP (YEL)	EA	$ 60.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
1201	504	12 INCH LED TRAF SIGNAL LAMP (YEL ARW)	EA	$ 60.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
1201		11 INCH LED TRAF SIGNAL LAMP (GRN)	EA	$ 60.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
1201	505	12 INCH LED TRAF SIGNAL LAMP (GRN ARW)	EA	$ 60.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
6031	506	COMMUN CABLE (25 PAIR) (22 AWG)	LF	$ 2.50		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
6519	501	DETECTOR UNIT	EA	$ 1,000.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
8230	501	LED PED SIG LAMP(SYMB)(2 IND/1 SEC)	EA	$ 250.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
8524	501	PED POLE ASSEM	EA	$ 2,500.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
8970	501	VIVDS PROCESSOR SYSTEM	EA	$ 2,900.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
8970	502	VIVDS CAMERA ASSEMBLY	EA	$ 1,600.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
8970	503	VIVDS SET UP SYSTEM	EA	$ 900.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
8970	505	VIVDS COMMUNICATION CABLE (COAXIAL)	LF	$ 0.85		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
6010	501	SALV TRAFFIC SIGNALS	EA	$ 2,700.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
		ADJUST DRAINAGE	LS	$ 15,000.00		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -		$ -
502	501	BARRICADES SIGNS AND TRAF HANDLE	MO	$3,500.00		$ -		$ -	0.13	$ 437.50	0.25	$ 875.00	1.00	$ 3,500.00	1.50	$ 5,250.00	0.03	$ 116.67	0.07	$ 233.33	0.03	$ 116.67	0.07	$ 233.33	1.00	$ 3,500.00	2.00	$ 7,000.00	1.00	$ 3,500.00	2.00	$ 7,000.00
		SUB TOTAL 1				$ -		$ -		$ 992.50		$ 1,430.00		$ 6,340.00		$ 11,930.00		$ 716.67		$ 1,433.33		$ 926.67		$ 1,353.33		$ 25,379.25		$ 36,465.96		$ 29,258.35		$ 43,337.31
XXX	XXX	BONDS	LS	5%		$ -		$ -		$ 49.63		$ 71.50		$ 317.00		$ 596.50		$ 35.83		$ 71.67		$ 46.33		$ 67.67		$ 1,268.96		$ 1,823.30		$ 1,462.92		$ 2,166.87
500	501	MOBILIZATION	LS	20%		$ -		$ -		$ 198.50		$ 286.00		$ 1,268.00		$ 2,386.00		$ 143.33		$ 286.67		$ 185.33		$ 270.67		$ 5,075.85		$ 7,293.19		$ 5,851.67		$ 8,667.46
		SUB TOTAL 2				$ -		$ -		$ 1,240.63		$ 1,787.50		$ 7,925.00		$ 14,912.50		$ 895.83		$ 1,791.67		$ 1,158.33		$ 1,691.67		$ 31,724.06		$ 45,582.45		$ 36,572.94		$ 54,171.64
XXX	XXX	MISCELLANEOUS & CONTINGENCY	LS	20%		$ -		$ -		$ 248.13		$ 357.50		$ 1,585.00		$ 2,982.50		$ 179.17		$ 358.33		$ 231.67		$ 338.33		$ 6,344.81		$ 9,116.49		$ 7,314.59		$ 10,834.33
		GRAND TOTAL				$ -		$ -		$ 1,488.75		$ 2,145.00		$ 9,510.00		$ 17,895.00		$ 1,075.00		$ 2,150.00		$ 1,390.00		$ 2,030.00		$ 38,068.88		$ 54,698.94		$ 43,887.53		$ 65,005.97
		CALLED				**$ 30,600.00**		**$ 47,500.00**		**$ 1,500.00**		**$ 2,200.00**		**$ 9,600.00**		**$ 17,900.00**		**$ 1,100.00**		**$ 2,200.00**		**$ 1,400.00**		**$ 2,100.00**		**$ 38,100.00**		**$ 54,700.00**		**$ 43,900.00**		**$ 65,100.00**
		AVERAGE UNIT COST (ROUNDED TO NEAREST $100)						**$ 39,100.00**				**$ 1,900.00**				**$ 13,800.00**				**$ 1,700.00**				**$ 1,800.00**				**$ 46,400.00**				**$ 54,500.00**

Note: Miscellaneous items include Engineering Design Fee, Survey and Material Testing.

Cost Estimates

				FACILITY AGENCY	CROSS STREETS HARRIS COUNTY								OTHER STAKEHOLDERS			
					D4 - EXTEND EXISTING TURN BAY				D5 - WIDEN TO 4 LANES (400 - 600 FT LONG)				F1 - CONNECT ADJACENT PROPERTIES			
ITEM	CODE	DESCRIPTION	UNIT	PRICE	LOW QTY.	LOW COST	HIGH QTY.	HIGH COST	LOW QTY.	LOW COST	HIGH QTY.	HIGH COST	LOW QTY.	LOW COST	HIGH QTY.	HIGH COST
104	501	REMOV CONC (PAV)	SY	$ 6.50		$ -		$ -	45.00	$ 292.50	67.50	$ 438.75		$ -		$ -
104	503	REMOV CONC (RIPRAP)	SY	$ 7.25		$ -		$ -	50.00	$ 362.50	75.00	$ 543.75		$ -		$ -
104	514	REMOV CONC (CURB)	LF	$ 4.00	225.00	$ 900.00	258.75	$ 1,035.00		$ -		$ -		$ -		$ -
104	531	REMOV (WHEELCHAIR RAMP)	EA	$ 160.00		$ -		$ -	2.00	$ 320.00	3.00	$ 480.00		$ -		$ -
110	501	EXCAVATION	CY	$ 4.00	70.00	$ 280.00	80.50	$ 322.00	513.58	$ 2,054.32	770.37	$ 3,081.48		$ -		$ -
160	503	FURN AND PLACE TOPSOIL	CY	$ 6.00	25.00	$ 150.00	28.75	$ 172.50	100.00	$ 600.00	150.00	$ 900.00		$ -		$ -
162	505	MULCH SODDING	SY	$ 1.35		$ -		$ -		$ -		$ -		$ -		$ -
166	502	FERTILIZER (20-10-10)	TON	$ 200.00		$ -		$ -		$ -		$ -		$ -		$ -
192	502	BEDDING PLANTS (4" POT)	EA	$ 1.75		$ -		$ -		$ -		$ -		$ -		$ -
260	505	LIME TREAT SUBGR (DC) (6")	SY	$ 1.55	140.00	$ 217.00	161.00	$ 249.55	1155.56	$ 1,791.11	1733.33	$ 2,686.66		$ -		$ -
276	526	CEM TRT BS (STR-O) TY (D1 OR D2) (GR 6) 6"	SY	$ 6.35	140.00	$ 889.00	161.00	$ 1,022.35	1155.56	$ 7,337.78	1733.33	$ 11,006.65		$ -		$ -
360	505	CONC PAV (CONT REINF HY STL) (10)	SY	$ 60.00	140.00	$ 8,400.00	161.00	$ 9,660.00	1155.56	$ 69,333.33	1733.33	$ 103,999.80		$ -		$ -
360	509	MONO CURB (6")	LF	$ 2.35	50.00	$ 117.50	57.50	$ 135.13		$ -		$ -		$ -		$ -
432	501	RIPRAP (CONC) (CL B)	CY	$ 250.00		$ -		$ -		$ -		$ -		$ -		$ -
465	559	MANH (COMPL) (TY M) (MOD)	EA	$ 4,750.00		$ -		$ -		$ -		$ -		$ -		$ -
479	501	ADJUST MANHOLE	EA	$ 1,500.00	1.00	$ 1,500.00	1.00	$ 1,500.00	3.00	$ 4,500.00	5.00	$ 7,500.00		$ -		$ -
529	505	CONC CURB (DOWEL) (6")	LF	$ 6.30	225.00	$ 1,417.50	258.75	$ 1,630.13	800.00	$ 5,040.00	1200.00	$ 7,560.00		$ -		$ -
531	502	CONCRETE SIDEWALKS	SY	$ 36.00		$ -		$ -		$ -		$ -		$ -		$ -
531	503	CONCRETE SIDEWALK (WHEELCHAIR RAMP)	SY	$ 100.00		$ -		$ -	2.00	$ 200.00	3.00	$ 300.00		$ -		$ -
666	506	REFL PAV MRK TY I (W) (8") (SLD)	LF	$ 1.00	120.00	$ 120.00	138.00	$ 138.00		$ -		$ -		$ -		$ -
666	509	REFL PAV MRK TY I (W) (12") (SLD)	LF	$ 3.00		$ -		$ -		$ -		$ -		$ -		$ -
666	512	REFL PAV MRK TY I (W) (24") (SLD)	LF	$ 5.00		$ -		$ -	50.00	$ 250.00	75.00	$ 375.00		$ -		$ -
666	513	REFL PAV MRK TY I (W) (ARROW)	EA	$ 150.00	1.00	$ 150.00	1.00	$ 150.00		$ -		$ -		$ -		$ -
666	517	REFL PAV MRK TY I (W) (ONLY)	EA	$ 200.00	1.00	$ 200.00	1.00	$ 200.00		$ -		$ -		$ -		$ -
666	533	REFL PAV MRK TY I (Y) (ISLAND)	SF	$ 2.25		$ -		$ -		$ -		$ -		$ -		$ -
666	502	REFL PAV MRK TY I (W) (4") (BRK)	LF	$ 1.00	225.00	$ 225.00	258.75	$ 258.75	800.00	$ 800.00	1200.00	$ 1,200.00		$ -		$ -
672	539	RAIS PAV MRK CL B (REFL) TY I-C (HV)	EA	$ 5.00	40.00	$ 200.00	46.00	$ 230.00		$ -		$ -		$ -		$ -
677	501	ELIM EXT PAV MRK & MRKR (4")	LF	$ 0.35		$ -		$ -		$ -		$ -		$ -		$ -
677	503	ELIM EXT PAV MRK & MRKR (8")	LF	$ 0.70		$ -		$ -		$ -		$ -		$ -		$ -
677	507	ELIM EXT PAV MRK ARROW	EA	$ 35.00		$ -		$ -		$ -		$ -		$ -		$ -
677	508	ELIM EXT PAV MRK WORD	EA	$ 35.00		$ -		$ -		$ -		$ -		$ -		$ -
678	503	PAV SURF PREP FOR MRKS (8")	LF	$ 0.10	120.00	$ 12.00	138.00	$ 13.80	800.00	$ 80.00	1200.00	$ 120.00		$ -		$ -
678	504	PAV SURF PREP FOR MRKS (12")	LF	$ 0.35		$ -		$ -		$ -		$ -		$ -		$ -
678	506	PAV SURF PREP FOR MRKS (24")	LF	$ 0.55		$ -		$ -	50.00	$ 27.50	75.00	$ 41.25		$ -		$ -
678	507	PAV SURF PREP FOR MRKS (ARROW)	EA	$ 6.00	1.00	$ 6.00	1.00	$ 6.00		$ -		$ -		$ -		$ -
678	508	PAV SURF PREP FOR MRKS (ONLY)	EA	$ 6.50	1.00	$ 6.50	1.00	$ 6.50		$ -		$ -		$ -		$ -
618	516	CONDUIT (PVC) (SCHD 80) (1 1/4")	LF	$ 5.50		$ -		$ -		$ -		$ -		$ -		$ -
618	518	CONDUIT (PVC) (SCHD 80) (2")	LF	$ 7.00		$ -		$ -		$ -		$ -		$ -		$ -
620	504	ELEC CONDUCTOR (NO. 6) BARE	LF	$ 0.70		$ -		$ -		$ -		$ -		$ -		$ -
620		ELEC CONDUCTOR (NO. 8) INSULATED	LF	$ 0.80		$ -		$ -		$ -		$ -		$ -		$ -
624	504	GROUND BOX TY D (162922) W/APRON	EA	$ 600.00		$ -		$ -		$ -		$ -		$ -		$ -
624	512	GROUND BOX TY 2	EA	$ 850.00		$ -		$ -		$ -		$ -		$ -		$ -
628	655	ELEC SERV TYD(120/240)070(NS)SS(E)SP(O)	EA	$ 2,950.00		$ -		$ -		$ -		$ -		$ -		$ -
636	501	ALUM SIGNS (TY A)	SF	$ 16.50		$ -		$ -		$ -		$ -		$ -		$ -
644	638	SM RD ASSM TY S80 (1) SA (U-BM)	EA	$ 600.00		$ -		$ -		$ -		$ -		$ -		$ -
644	501	SMALL SIGN RDSD SGN ASSM (TY A)	EA	$ 500.00	1.00	$ 500.00	1.00	$ 500.00	6.00	$ 3,000.00	9.00	$ 4,500.00		$ -		$ -
649	502	REMOV AND RELOC SMALL RDSD SGN ASSM	EA	$ 500.00		$ -		$ -		$ -		$ -		$ -		$ -
649	504	REMOV SMALL RDSD SGN ASSM	EA	$ 55.00	1.00	$ 55.00	1.00	$ 55.00	6.00	$ 330.00	9.00	$ 495.00		$ -		$ -
656	518	TRAF SIG CNTRL FND	CY	$ 1,250.00		$ -		$ -		$ -		$ -		$ -		$ -
656	542	FND FOR TRAF SIG (TY A) (36 IN DR SH)	LF	$ 150.00		$ -		$ -		$ -		$ -		$ -		$ -
656	543	FND FOR TRAF SIG (TY B) (36 IN DR SH)	LF	$ 150.00		$ -		$ -		$ -		$ -		$ -		$ -
680	502	INSTAL OF HWY TRAF SIG (SYSTEM)	EA	$ 11,400.00		$ -		$ -		$ -	1.00	$ 11,400.00		$ -		$ -
682	502	VEH SIG SEC (12 IN)	EA	$ 165.00		$ -		$ -		$ -		$ -		$ -		$ -
682	510	BACK PLATE (4 SEC) (12 IN)	EA	$ 90.00		$ -		$ -		$ -		$ -		$ -		$ -
684	544	TRAF SIG CBL (TY A) (7 CONDR) (16 AWG)	LF	$ 0.75		$ -		$ -		$ -		$ -		$ -		$ -
684	570	TRAF SIG CBL (5 CONDR) (14 AWG)	LF	$ 1.00		$ -		$ -		$ -		$ -		$ -		$ -
688	511	VEH DETECT (SAWCUT)	LF	$ 5.80		$ -		$ -		$ -		$ -		$ -		$ -
688	501	PED DETECT (PUSH BTN)	EA	$ 150.00		$ -		$ -		$ -		$ -		$ -		$ -
1201	501	12 INCH LED TRAF SIGNAL LAMP (RED)	EA	$ 60.00		$ -		$ -		$ -		$ -		$ -		$ -
1201		11 INCH LED TRAF SIGNAL LAMP (YEL)	EA	$ 60.00		$ -		$ -		$ -		$ -		$ -		$ -
1201	504	12 INCH LED TRAF SIGNAL LAMP (YEL ARW)	EA	$ 60.00		$ -		$ -		$ -		$ -		$ -		$ -
1201		11 INCH LED TRAF SIGNAL LAMP (GRN)	EA	$ 60.00		$ -		$ -		$ -		$ -		$ -		$ -
1201	505	12 INCH LED TRAF SIGNAL LAMP (GRN ARW)	EA	$ 60.00		$ -		$ -		$ -		$ -		$ -		$ -
6031	506	COMMUN CABLE (25 PAIR) (22 AWG)	LF	$ 2.50		$ -		$ -		$ -		$ -		$ -		$ -
6519	501	DETECTOR UNIT	EA	$ 1,000.00		$ -		$ -		$ -		$ -		$ -		$ -
8230	501	LED PED SIG LAMP(SYMB)(2 IND/1 SEC)	EA	$ 250.00		$ -		$ -		$ -		$ -		$ -		$ -
8524	501	PED POLE ASSEM	EA	$ 2,500.00		$ -		$ -		$ -		$ -		$ -		$ -
8970	501	VIVDS PROCESSOR SYSTEM	EA	$ 2,900.00		$ -		$ -		$ -		$ -		$ -		$ -
8970	502	VIVDS CAMERA ASSEMBLY	EA	$ 1,600.00		$ -		$ -		$ -		$ -		$ -		$ -
8970	503	VIVDS SET UP SYSTEM	EA	$ 900.00		$ -		$ -		$ -		$ -		$ -		$ -
8970	505	VIVDS COMMUNICATION CABLE (COAXIAL)	LF	$ 0.85		$ -		$ -		$ -		$ -		$ -		$ -
6010	501	SALV TRAFFIC SIGNALS	EA	$ 2,700.00		$ -		$ -		$ -		$ -		$ -		$ -
		ADJUST DRAINAGE	LS	$ 15,000.00		$ -		$ -	1.00	$ 15,000.00	1.50	$ 22,500.00		$ -		$ -
502	501	BARRICADES SIGNS AND TRAF HANDLE	MO	$3,500.00	1.00	$ 3,500.00	2.00	$ 7,000.00	3.00	$ 10,500.00	4.50	$ 15,750.00		$ -		$ -
		SUB TOTAL 1				$ 18,845.50		$ 24,284.70		$ 121,819.04		$ 194,878.34		$ -		$ -
XXX	XXX	BONDS	LS	5%		$ 942.28		$ 1,214.24		$ 6,090.95		$ 9,743.92		$ -		$ -
500	501	MOBILIZATION	LS	20%		$ 3,769.10		$ 4,856.94		$ 24,363.81		$ 38,975.67		$ -		$ -
		SUB TOTAL 2				$ 23,556.88		$ 30,355.88		$ 152,273.80		$ 243,597.92		$ -		$ -
XXX	XXX	MISCELLANEOUS & CONTINGENCY	LS	20%		$ 4,711.38		$ 6,071.18		$ 30,454.76		$ 48,719.58		$ -		$ -
		GRAND TOTAL				$ 28,268.25		$ 36,427.05		$ 182,728.56		$ 292,317.51		$ -		$ -
		CALLED				**$ 28,300.00**		**$ 36,500.00**		**$ 182,800.00**		**$ 292,400.00**		**$ 17,000.00**		**$ 33,000.00**
		AVERAGE UNIT COST (ROUNDED TO NEAREST $100)						**$ 32,400.00**				**$ 237,600.00**				**$ 25,000.00**

Note: Miscellaneous items include Engineering Design Fee, Survey and Material Testing.

TxDOT	LOW COST	HIGH COST
Signal Coordination	$ 2,700	$ 3,105
EMS Devices	$ 750	$ 863
Overhead Steet Name Signs	$ 2,400	$ 2,760
Signal Back Plates	$ 1,800	$ 2,070
Communications Synchronization	$ 750	$ 863
TOTAL	$ 8,400	$ 9,661
AVERAGE UNIT COST (ROUNDED TO NEAREST $100)		**$ 9,000**
Grade Separation	$ 15,000,000	$ 18,000,000
AVERAGE UNIT COST (ROUNDED TO NEAREST $100)		**$ 16,500,000**

METRO	LOW COST	HIGH COST
H.3 - Add Bench at Bus Stop	$ 2,000	$ 3,000
AVERAGE UNIT COST (ROUNDED TO NEAREST $100)		**$ 2,500**
H.4 - Add Shelter at Bus Stop	$ 20,000	$ 25,000
AVERAGE UNIT COST (ROUNDED TO NEAREST $100)		**$ 22,500**

Harris County	LOW COST	HIGH COST
G - New Roadway (4-lanes, cost per mile)	$ 4,000,000	$ 4,800,000
AVERAGE UNIT COST (ROUNDED TO NEAREST $100)		**$ 4,400,000**

Private Developers	LOW COST	HIGH COST
G - New Roadway	$ 4,000,000	$ 4,800,000
AVERAGE UNIT COST (ROUNDED TO NEAREST $100)		**$ 4,400,000**

City of Houston	LOW COST	HIGH COST
D.5 - Widen to 4 Lanes	$ 1,930,400	$ 3,087,800
AVERAGE UNIT COST (ROUNDED TO NEAREST $100)		**$ 2,509,100**