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Paving & Drainage Improvements
Need Area NT R1: West Fuqua Street
Missouri City Limits To Chimney Rock Road

Preliminary Engineering Report
WBS: N-000100-0005-3
March 2013

PRE-ENGINEERING NEED AREA NT R1 W. FUQUA STREET FROM CHIMNEY ROCK TO MISSOURI CITY, CITY LIMIT.

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1. Executive Summary

This Pre-Engineering study is prepared by OMEGA ENGINEERS, INC. (OMEGA) for the COH under the terms of the Contract for Professional Engineering Services for Pre-Engineering services for Fuqua Street from Missouri City Limit to Chimney Rock Road, WBS No. N-000100-0005-3

The development of information contained herein based on field investigations, information from GIMS data available of the COH website, data provided by the COH, correspondence with private utilities, and information from Fort Bend County Appraisal to understand and evaluate existing conditions. Therefore, all information provided, established by the best available means within the scope of this study, should be considered approximate. The results of OMEGA's investigations and observations are listed below.

The purpose of the study is to provide assessment of existing conditions, identify the needs, provide alternative solutions and recommendations for street and paving improvements, drainage concepts, water line and sanitary sewer utility improvements, and cost estimates.

Study Area Location

The study area along W. Fuqua Street is located approximately 14.2 miles southwest of downtown Houston in Fort Bend County, Texas. The study area is located in Council District K with limits from Missouri City city limits to Chimney Rock Road. Super neighborhood is Fort Bend/Houston. Subdivisions; Meadow Crest SEC2, Briar Gate Sections (1, 2, 4, 5, 6, 8, 9, 10, 12, 13, 18, 19), and West Bend. The relevant Key Map numbers are 570Z, and 571W. GIMS block map numbers are 5150a and 5050b.

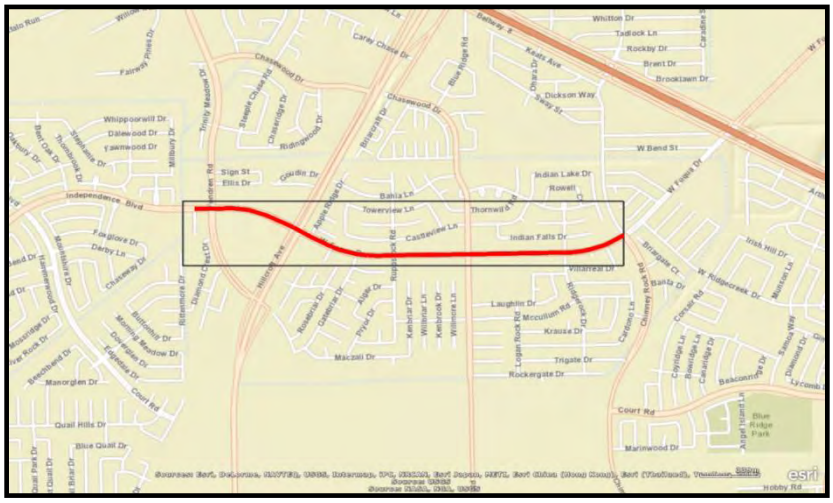


Figure 1 - Study Location W. Fuqua Street

Existing Conditions

W. Fuqua Street is a four lane divide curb and gutter Street within 100 foot wide right-of-way (ROW), and is designated as a T-4-100 in the 2012 Major Thoroughfare and Freeway Plan (MTFP). Posted speeds within the study area are 30 and 35 MPH. There is a 32-foot median that separates each direction of traffic from Fondren Road to Chimney Rock Road. Land use along W. Fuqua is primarily single-family residential and commercial.

The existing concrete pavement is generally in fair condition; however, there are damaged curbs throughout the study area limits. The pedestrian facilities, including ramps, sidewalks, and bus shelters, are generally in poor condition. The outside lane is typically used for on-street parking which allows for only one accessible lane at any given time. The inlets are mostly type BB inlets, and there are several areas of ponding near and along the gutter of the roadway. The following are block-by-block assessments of W. Fuqua Street along with the Pavement Condition Rating (PCR). Our assessment is based on site visits performed January 27 and 28, 2013. Corresponding photos are attached; photos layout A is a general view of the study area, and layout B is specific to issues and deficiencies.

Needs Identification

Needs Identification is evaluated in three major categories; Street and Traffic, Drainage and Utility Needs (Water and Wastewater).

Street and Traffic needs identification was evaluated based on the physical condition and capacity of the roadway. For the segment between Chimney Rock to Fondren, the pavement condition rating (PCR) provided by COH indicates that the existing concrete pavement is in fair condition with an average rating of 62.9. However, the pavement is over 40 years old and shows wide cracks, failure at joints, and numerous asphalt patches. Pavement cracks have been sealed with asphalt to prevent water intrusion into the sub-grade. The physical deficiencies noted also include missing curbs, sidewalks in poor condition and lack of wheelchair ramps at cross streets.

Sidewalks are generally in fair condition however the wheelchair ramps are not compliant with current ADA standard.

The results of Level of Service (LOS) analysis indicate that 2013 LOS is C for the entire length of the study area. The 2035 LOS is F applying the existing roadway geometry.

A preliminary analysis was performed to determine if the existing drainage systems have the capacity to drain the existing flows from their respective drainage areas based on COH's current standards. Drainage areas for the systems were developed from information obtained by COH.

The drainage areas were further divided into sub-drainage areas generally corresponding with changes in pipe sizes at manholes along the drainage system.

The Rational method was used to compute the 2-year and 100-year design peak flows. Capacity of the existing storm sewer systems was computed using Manning's formula. The hydraulic information on the pipes such as flowline, size, length, and material were obtained from COH GIMS (Geographic Information & Management System). The capacity of the existing roadside ditches which serve as outfall locations of the drainage systems was computed using a 2 feet/second flow velocity and the ditch cross-sectional flow area.

The 2-year design peak flows for sub-drainage areas were compared with the capacity of the corresponding segment of the drainage system. If the capacity of the drainage segment was greater than the design flows, then the drainage segment was identified as having adequate capacity; otherwise, the drainage segment was identified as inadequate to convey the design flows.

Proposed Alternatives

Based on the traffic evaluation, data provided by the COH, and data collected from field visits, four alternative solutions were developed for W. Fuqua. The alternatives were grouped based on the extent of the work proposed and the cost of improvements. W. Fuqua was constructed in the 1970's. Paving standards have been revised and elements were added over the years. These standards have been taken into consideration in developing the alternatives, e.g.: bicycle routes, ADA compliant ramps, and other pedestrian circulation elements to bring the existing facility up to current standards. These pedestrian circulation elements and more are focused on because of the presence of churches, a public library, three schools, residential units, and commercial and retail facilities within the area of study.

The COH Water Operations recommended that the existing 16" main be replaced with a new 24" main, which coincides with the new 24" line installed in the median east of Bazel Brook. This recommendation was taken into consideration in developing each alternative. The location of the proposed water main is dependent upon the locations of other utility lines; however, based on the location of the new main east of Bazel Brook, it is suggested that the new water main be located in the median.

Traffic improvements to provide acceptable levels of services at intersections for all alternatives would include the addition of a second left turn lane on eastbound W. Fuqua at Fondren, a left turn lane on eastbound W. Fuqua at Hilcroft, and converting the All-way Stop at Ridgecreek to a signalized intersection.

Alternative A focuses on localized repairs for pavement damages by replacing the faulty concrete panels, damaged curb and sidewalk. The suggested drainage improvement is by replacing damaged inlet tops, and leads. As for sidewalks, spot repairs would be accomplished by replacing damaged areas, relocating sidewalk away from manholes, and installing or replacing ADA ramps.

Alternative B involves rebuilding the roadway with the existing section from Houston City limits to Chimney Rock Road. The proposed section (same as existing section) and detailed layouts are shown in Exhibits 4.1 and Layout 8.1 to 8.7. Storm water drainage improvements would involve increasing the capacity of the existing systems to provide in-line storage.

Alternative C provides a wider range of improvements and upgrades. The existing 24ft road section will be replaced with a 28-foot wide section to provide a shared use lane for bicycles on both east and westbound outside lanes. The extra space required for improvement will be taken from the 32 ft wide median making it 24 ft wide. The proposed section and detailed layouts are shown in Exhibits 4.2 and Layout 9.1 to 9.7. Also, adding left turn storage length and signalizing more intersections to improve traffic. Storm water drainage improvements would involve increasing the capacity of the existing systems to provide in-line storage.

Alternative D was developed to address the inadequacy of the existing drainage systems within the study area. This solution provides a separate drainage system that runs along W. Fuqua from Ruppstock to the Sims Bayou tributary outfall east of Bazel Brook. Analysis of this alternative indicated that similar roadway improvements are required between Chimney Rock and Bazel Brook.

The roadway between Bazel Brook and the Sims Bayou tributary appears to have been upgraded recently. The roadway section from Bazel Brook to Missouri City limit west would be rebuilt using the existing section, as shown in Exhibit No.5.

Estimated Construction Cost

Construction cost estimates were developed based on proposed improvements for each alternative. These costs were developed based on anticipated roadway, drainage, and water and wastewater estimated construction costs, as well as estimated engineering and construction management costs. The estimated total project costs for each alternative are as follows:

Alternative A:	$3.45 mil
Alternative B:	$21.07 mil
Alternative C:	$21.56 mil
Alternative D:	$21.76 mil

Candidate Project Development

In developing the Candidate project, each alternative was analyzed in terms of project scope, overall estimated cost and Candidate Project Priority Score. Alternative D has the highest scoring alternative of the full reconstruction alternatives being considered. The proposed roadway section would match what was used for the previously reconstructed portion of W. Fuqua between Bazel Brook and the Beltway. And it would reconstruct the remaining portion of W. Fuqua between the city limits and the Beltway.

Alternative D would also address storm sewer capacity issues for the systems within the Briargate subdivision, and their outfall channel by diverting runoff within the W. Fuqua drainage area further to the east.

Recommendations

Alternative D is recommended for further development as the Candidate Project for Need Area NT R1. This alternative would provide the City the opportunity to divide it into two or three subprojects, depending on available funds and maximum project size. These subprojects could be sequenced from east to west, allowing construction of the redirected storm sewer system to be built from its outfall. It would also allow for extension of the existing 24" water main, east of Bazel Brook, to replace the 16" main within the study area.

2. *Introduction*

A. Study Area Location

The study area along W. Fuqua Street is located approximately 14.2 miles South West of Downtown Houston in Fort Bend County, Texas. The study area is located in Council District K with limits from Missouri City city limits to Chimney Rock Road. Super neighborhood is Fort Bend/Houston. Subdivisions; Meadow Crest SEC2, Briar Gate Sections (1, 2, 4, 5, 6, 8, 9, 10, 12, 13, 18, 19), and West Bend. The relevant Key Map numbers are 570Z, and 571W. GIMS block map numbers are 5150a and 5050b.

B. Study Authorization

The COH, Infrastructure Planning Branch, Planning and development services Division (COH-PDSD) contracted with Omega Engineers, Inc. to provide pre-engineering services for Street Paving and Drainage Improvements Need area NT R1 W. Fuqua Street from Chimney Rock Road to Missouri City city limit.

C. Problem Source

W. Fuqua Street was chosen for pre-engineering due to the condition of the existing pavement condition and the mobility challenges in the area surrounding the need area due to the age of the road and degradation. Omega Engineers completed Planning 1- Problem Identification and submitted a report summarizing the findings on February 06, 2013.

D. Study Purpose and Justification

- Poor Pavement condition
- Outdated roadway
- Inefficient drainage system
- Sub-standard pedestrian circulation
- Non- compliant for ADA
- Water main upgrade required
- Unacceptable levels of service at some intersections

3. *Data Collection and Evaluation*

Omega Engineers gathered the data used for the study of the W. Fuqua paving and drainage problems from various sources like; traffic counts, as built documents, field visits and photo documentation, GIS analysis, City of Houston GIMS, and other data provided by the City of Houston.

4. *Problem Identification*

Existing Conditions

W. Fuqua Street is a suburban boulevard section, with posted speed limits of 30 and 35 mile per hour (mph). The roadway is a four-lane divided section with a raised median within a 100 foot right-of-way (ROW), and is designated as a T-4-100 in the COH 2012 Major Thoroughfare and Freeway Plan (MTFP). There is a 32-foot median that separates each direction of traffic from Chimney Rock Road to Fondren; W. Fuqua is adjacent to primarily single-family residential and commercial uses.

W. Fuqua Street is an existing concrete pavement, curb and gutter. The concrete pavement is generally in poor condition with damaged curb and gutter throughout the study area limits. The pedestrian facilities, including ramps, sidewalks, and bus shelters, are generally in poor condition. The outside lane is typically used for on-street parking which allows for only one accessible lane at any given time, but primarily during over night off peak hours. The inlets are mostly type BB inlets, and there are several areas of ponding near and along the gutter of the roadway. The following are block-by-block assessments of W. Fuqua Street along with the Pavement Condition Rating (PCR). Our assessment is based on site visits performed January 27 and 28, 2013. Corresponding photos are attached, with Layout A being a general view of the study area, and. Layout B being specific to issues and deficiencies with identified below:

Figure 2 –W. Fuqua Road Segments

1- COH limit to Fondren-80-ft section (face to face) (32 ft grassy median)

- 4-foot sidewalks on both sides of W. Fuqua
- Irregular curb alignment on both East and West bound
- Cracked and damaged pavement surface
- Several potholes on both sides of the roadway (see photo 1B)
- Adjacent to drainage channel, and residential properties (see photo 2B)

2- Fondren to Hillcroft -80-ft section (face to face) (32 ft grassy median)

- 4-foot sidewalks on both sides of W. Fuqua

- Pavement failure on various locations (see photo 3B)
- Cracked and damaged curb on various locations but relatively better condition than other sections
- Ponding along gutter of the roadway
- Southern preparatory academy, Fondren Southwest Seventh Day Adventist Church, unused land

3- Hillcroft to Gate Briar-80-ft section (face to face) (32 ft grassy median)

- 4-foot sidewalk on East bound and missing from West bound of W. Fuqua (see photo 5B)
- Pavement failure on various locations
- Cracked and damaged concrete pavement on various locations
- cracked curb with exposed rebar (see photo 6B)
- Ponding along roadway gutters
- Passes under Fort Bend Toll Way
- Adjacent to Dollar general store, unused land, and residential units

4- Gate Briar to Ruppstock-80-ft section (face to face) (32 ft grassy median)

- 4-foot sidewalks on both sides of W. Fuqua
- Faded pavement markings on crossing areas and other pavement markings
- Ponding along gutters or roadway
- Cracked and damaged sidewalks (see photo 7B)
- Cracked and damaged concrete pavement on various locations (see photo 8B)
- Pavement failure on various locations
- Adjacent to single family residential properties

5- Ruppstock to Blue Ridge-80-ft section (face to face) (32 ft grassy median)

- 4-foot sidewalks on both sides of W. Fuqua
- Water ponding caused by malfunction in the irrigation system of medians located on W. Fuqua and Blue Ridge (see photo 9B)
- Faded pavement markings on crossing areas and other pavement markings (see photo 10B)
- Scoured soil behind storm water drain (see photo 11B)
- Cracked concrete pavement in various locations
- Damaged and missing curbs
- Damaged, cracked sidewalk
- Adjacent to various commercial, and single family residential properties (see photo 12B)

6- Blue Ridge to Ridge Rock-80-ft section (face to face) (32 ft grassy median)

- 4-foot sidewalks on both sides of W. Fuqua
- Cracked concrete pavement in various locations (see photo 13B)
- Pavement failure (see photo 14B)
- Damaged curb and cracked curb with missing parts (see photo 15B)
- Irregular curb alignment on both East and West bound

- Ponding along gutters of roadway
- Cracked concrete storm water inlets
- Cracked and damaged side walk on various locations(see photo 16B)
- Faded pavement markings on crossing areas and other pavement markings
- Adjacent to Sherman E. Stimley-Blue Ridge Public Library, single family residential units, and unused land

7- Ridge Rock to Briar Stead-80-ft section (face to face) (32 ft grassy median)

- 4-foot sidewalks on both sides of W. Fuqua
- Cracked concrete pavement in various locations
- Pavement repairs (see photo 17B)
- Cracked concrete storm water inlets with poor repair (see photo 18B)
- Several potholes of both directions of the street
- Damaged and missing curbs
- Irregular pavement joints repairs causing bad pavement surface (see photo 19B)
- Ponding along roadway gutters
- Faded pavement markings on crossing areas and other pavement markings
- Adjacent to single family residential properties on both sides

8- Briar Stead to Chimney Rock- 80-ft section (face to face) (32 ft grassy median)

- 4-foot sidewalks on both sides of W. Fuqua
- Damaged curb and cracked curb with exposed rebar (see photo 20B)
- Missing curb parts (see photo 21B)
- Ponding along gutter of roadway
- Cracked concrete storm water inlets (see photo 22B)
- Faded pavement markings on crossing areas and other pavement markings
- Adjacent to Valero fuel station, various stores, and single family residential property

PCR scores for each of these segments are summarized in Table 1 below:

Table 1 - PCR Scores for W. Fuqua Street per Segment

W. Fuqua Street	PCR Scores
COH limit to Fondren	60.1
Fondren to Hillcroft	64.26
Hillcroft to Gate Briar	59.49
Gate Briar to Ruppstock	61.7
Ruppstock to Blue Ridge	65.87
Blue Ridge to Ridge Rock	63.9
Ridge Rock to Briar Stead	62.16
Briar Stead to Chimney Rock	65.88

Pavement condition ratings are categorized based on the scale in Table 2 below:

Table 2 – Pavement Condition Rating Scale

Condition Level	Rating
High	78.6 – 100
Medium-high	72.0 – 78.6
Medium	64.9 – 72.0
Medium-low	59.0 – 64.9
Low	35.0 – 59.0

Ratings for the segments within the study area range from 65.88 on the high end to 59.49 on the low end. This places the need area in the Medium to Medium-low region of the ratings scale, with the majority of segments falling within the Medium-low range.

Right-of-Way

As per Fort Bend Central Appraisal District (FBCAD) Facet Maps, the existing Right-of-Way for W. Fuqua Street between Chimney Rock and Missouri City city limits is 100ft.

Pedestrian Circulation System

Pedestrian circulation is very important due to the close proximity of residential developments, branch library, and local schools. Most residential and commercial tracts along Fuqua Street were developed to include sidewalks. However, there are a number of areas where the pedestrian facilities are noncompliant for ADA and require extensive repairs. Conflicts occur in areas where manholes have been placed within the sidewalks, and uneven settling has caused certain sections to become broken and impassable.

Metro System

METRO Bus Route #98 runs in both directions along Fuqua Street with 14 stops and services destinations like Alameda Station, Hiram Clarke Multi Service Center, Hiram Clarke Transit center, Missouri City Park and Ride. W. Fuqua has one covered bus stop within the study area limits. Also, several uncovered bus stops with concrete bench and without.

Schools

There are two private schools and a public elementary school in the need area. The two private schools are located at or close to the intersection of W. Fuqua and Fondren. The public elementary school is located a block south of W. Fuqua on Laughlin Drive at Blueridge Road. Although school crossing signs are located in the area of W. Fuqua and Blueridge, no school zones have been established within the need area.

COH Major Thoroughfare Plan

The COH Major Thoroughfare Plan (MTFP) designates W. Fuqua Street as a Major Thoroughfare with sufficient right-of-way width (T-4-100) within the study area

Inter-Agency Coordination

Omega Engineers coordinated with the City's Inter-Agency Coordination Group (IAGCG) to identify other City, Metro, TxDOT, or Railroad facility projects that could impact the final design of the proposed roadway. Currently, there are no proposed projects in the vicinity of this study area.

Utilities

Public Utilities

Water

An existing 16-inch water main extends from Fondren to Chimney Rock along the north side of the roadway. The line west of Ruppstock is asbestos concrete (AC) pipe, and the line east of Ruppstock is cast iron (CI) pipe. The line located between the Missouri City city limits and Fondren is a 12-inch PVC line.

For the extended study area required for Drainage Alternative 4, the existing line between Chimney Rock and Bazel Brook is a 24-inch AC line. This line extends about 100 feet east of Bazel Brook where it ties into a new 24-inch PVC line which cross over then runs in the median toward Beltway 8.

Table 3 lists the diameter and type of existing waterline crossing W. Fuqua at each intersection:

Table 3 – Existing Water Main Crossings at Cross Streets

Intersecting Street	Size	Type	Intersecting Street	Size	Type
Fondren	16"	AC, CI	Ridgerock	8" 12"	AC AC
Hilcroft	24" 8"	Stl AC	Raynor	2"	PVC
Appleridge	8"	AC	Briarstead	8"	AC
Homebriar	6"	AC	Chimney Rock	12" 12"	PVC AC
Gatebriar	12"	AC	Ridgecreek	16"	AC
Ruppstock	16"	CI	Summer Ridge	8"	AC
Blue Ridge	16"	CI	Bazel Brook	8"	AC

The COH Infrastructure Planning Branch has recommended that the existing line between Fondren and Chimney Rock be upgraded to a 24-inch line. The new line could be located within the median. This upgrade would also apply to the extended study area for Drainage Alternative 4, and tie to the new 24-inch PVC line located in the median east of Bazel Brook.

Wastewater

The study area is located within the Greenridge Wastewater Service area. There is an existing wastewater main extending along the entire length of the project along the south side of the roadway, flowing from west to east. The size of this pipeline ranges from 18-inch RCP on the west, increasing to a 42-inch MRC (monolithic reinforced concrete pipe) through the Chimney Rock intersection.

COH Wastewater Operations provided CTV records of the line that indicated several segments on the west side between Fondren and Hilcroft with a MLR rating of 12. The majority of the remaining segments carried a MLR rating of zero, with the exception of two 12's, one 8 and two with ratings less than 1. The City also provided an exhibit showing peak flow, pipe capacity, and contributing area, verifying that the existing line is operating at between 28% and 50% of its capacity (Exhibit 10). The City has also recommended the installation of a 10-inch stub out to the north at the Ridgerock intersection to tie to a proposed gravity line from the north (Exhibit 11).

Private Utilities

Electric

Electric service is provided by CenterPoint Energy via overhead and underground lines within the study area. CenterPoint poles are located along the south right-of-way line throughout the study area. Additionally, standalone roadway illumination standards are located along both sides of the right-of-way, and are powered via underground connections. Anticipated roadway and drainage improvements will not impact the location of power poles or illumination standards. However, underground lines may have to be relocated to accommodate new water and storm sewer lines.

Gas

There is no information concerning natural gas services within the study area. It appears that no service lines are present.

Telecom and Cable TV

Overhead and underground telecommunications facilities are owned by AT&T Texas SBC. Overhead facilities are mounted on CenterPoint Energy poles.

Overhead and underground cable TV services are owned by Comcast. Overhead facilities are also mounted on CenterPoint poles.

Similar to electric utilities, underground telecom and cable TV cables may have to be relocated to accommodate new water and storm sewer lines.

Petro -Chemical Pipelines

A review of the Texas Railroad Commission database indicates there are three pipelines contained in two easements within the study area, located between Fondren and Hilcroft. One easement contains a crude oil transmission line. There are no markers or signs designating the location of this pipeline, which may or may not indicate that the pipeline has been abandoned.

The second easement contains two pipelines, one of which is a crude gathering pipeline, and the second is a non-HVL liquid products transmission line, which are marked with signs and markers at the right-of-way on each side of the roadway.

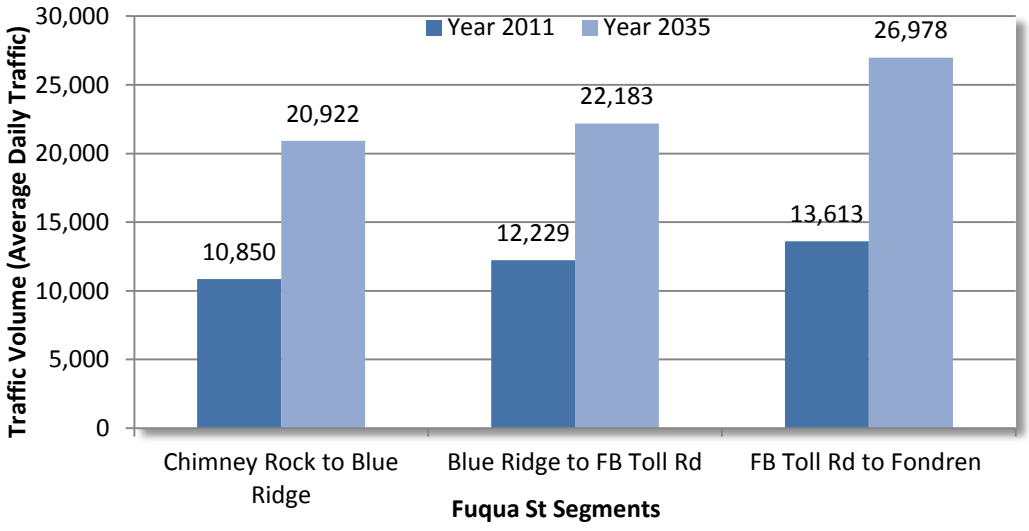
On Street Parking

Most of the study area is located within the Briargate subdivision, with single-family and multi-family residences being accessed directly from the street. As a result, on-street parking is permitted. However, it appears that that most residents use driveways and off-street parking pads, with occasional overflow on the street, as observed during most of the site visits. On-street parking seemed to be more prevalent during evening and overnight off peak hours. Therefore, there could be some restricted mobility due to on-street parking during the earlier portions of the AM peak. The face to face width of each half Fuqua Street within the study area is 24-feet, limiting traffic to one through lanes when vehicles are parked in the roadway.

Traffic

In general, the competing goals of safety and mobility are needed throughout the corridor for operations and safety. As described above, the traffic flow along Fuqua Street is constrained by the All-Way STOP Control intersections, W. Fuqua Street at Ridgerock Drive and W. Fuqua Street at W. Ridgecreek Drive, the T-intersection about 300 ft. east of Chimney Rock Road (outside the study area limit). The traffic volumes will continue to increase along Fuqua Street; therefore, these two intersections may require signalization or may warrant conversion to Minor Approach and/or Two-Way STOP Control operation in order to maintain the traffic flow at acceptable levels of service.

Chart 1: Fuqua Street Comparison of Year 2011 and 2035 - ADT



Existing and Projected Average Daily Traffic (ADTs)

Per the data provided by the COH, the annual growth rate of traffic between 2011 and 2035 for different segments of W. Fuqua Street is estimated to be as follows:

Segment-1: The annual growth rate on Fuqua Street between Chimney Rock and Blueridge = 2.77%

Segment-2: The annual growth rate on Fuqua Street between Blueridge Road to FB Toll Road = 2.51%

Segment-3: The annual growth rate on Fuqua Street between FB Toll Road to Fondren Road = 2.89%

In general, the overall growth rate between Chimney Rock and Fondren Street = 3.86%

Drainage

A preliminary analysis was performed to determine if the existing drainage systems have the capacity to drain the existing flows from their respective drainage areas based on COH's current standards. Drainage areas for the systems were developed from information obtained by COH. The drainage areas were further divided into sub-drainage areas generally corresponding with changes in pipe sizes at manholes along the drainage system.

The Rational method was used to compute the 2-year and 100-year design peak flows. Capacity of the existing storm sewer systems was computed using Manning's formula. The hydraulic information on the pipes such as flowline, size, length, and material were obtained from COH GIMS (Geographic Information & Management System). The capacity of the existing roadside ditches which serve as outfall locations of the drainage systems was computed using a 2 feet/second flow velocity and the ditch cross-sectional flow area.

The 2-year design peak flows for sub-drainage areas were compared with the capacity of the corresponding segment of the drainage system. If the capacity of the drainage segment was greater than the design flows, then the drainage segment was identified as having adequate capacity; otherwise, the drainage segment was identified as inadequate to convey the design flows.

1. Study Area Location and Description

The study area is comprised of thoroughfare improvements to W. Fuqua Street between Fondren Road and Chimney Rock Road, a length of approximately 8,000 feet, or 1.5 miles. The need area is located in Fort Bend County within the City of Houston, beginning just east of the Missouri City limits, and extends east to just south of the Fort Bend/Harris county line, southwest of downtown Houston. The existing W. Fuqua Street is a four-lane boulevard section.

2. FEMA Special Flood Hazard Areas

The study limits along W. Fuqua Street are located within unshaded FEMA Zone X outside the 100-year and 500-year floodplain of Sims Bayou. The study area is located within FEMA FIRM Panel No. 48201C0985L and 48201C1005L. The study limits are shown in **EXHIBIT 12A EXISTING STORMWATER DRAINAGE SYSTEMS**.

3. Existing Drainage Conditions

Design Drainage Area, Peak Flow, and Capacity

The need area is located within the Sims Bayou Watershed, and consists of seven (7) drainage systems which begin at the high point along W. Fuqua Street as described below in **Table 4a**:

Table 4a: Need Area Drainage Systems Summary

System	Location	Limits		Includes
		From	Outfall	
A	Fondren Rd/W. Fuqua St	W. Fuqua St	Ditch-N	Fondren Rd
B	W. Fuqua St	W. Fuqua St, 605' west of Hillcroft Rd	Ditch-W	
C	W. Fuqua St	W. Fuqua St, 1480' east of Hillcroft Rd	Ditch-W	
D	Ruppstock Rd	W. Fuqua St	Ditch-N	Castleview Ln, Frostview Ln, Towerview Ln, Bahia Ln, Briargate Ct
E	Blueridge Rd	W. Fuqua St	Ditch-N	Castleview Ln, Thornwild Rd, Briargate Dr, Bahia Ln
F	Castleview Ln	W. Fuqua St, 525’ east of Blueridge Rd	Ditch-N	Indian Falls Dr, Castleview Ln, Ohara Dr, Thornwild Rd, Briargate Dr
G	Chimney Rock Rd	W. Fuqua St	Ditch-N	Chimney Rock Rd, Indian Falls Dr, Castleview Ln, Ridge Rock Dr, Briargate Dr, Rowell Ct

The land use in the need area is generally comprised of single-family residential areas.

Extreme Event Analysis

The 100-year extreme event was imposed on the existing drainage systems and analyzed for capacity.

Findings

After analyzing the existing storm sewer systems for the design year storm, the analysis shows that Systems C through G are undersized. The drainage area, peak flow, and drainage system capacity for Systems A through G are summarized in **APPENDIX F, Table 1. Need Area Drainage Systems Calculations (Preliminary).**

The capacity of the existing ditch to the north of the need area which serves as the outfall location of drainage Systems A and D through G, and the existing ditch along Hillcroft Avenue which serves as the outfall location of drainage Systems B and C were analyzed. These ditches are the drainage system for the Fort Bend Tollway, and their capacities are presented below in **Table 4b**.

Table 4b. Need Area Drainage Ditch Summary

SYSTEM ID	Location	2-year Flow* (cfs)	100-year Flow* (cfs)	EXISTING SYSTEM				
				Bot Width (ft)	Top Width (ft)	Depth (ft)	Velocity (ft/s)	Capacity (cfs)
Ditch - N	North of need area	366.1	769.3	60	160	12.5	2	2750
Ditch - W	At Hillcroft Ave.	84.8	178.7	30	120	6.0	2	900

*Contributing flows are from need area only

Methods to detain the current design flows were considered: in-line detention within the current drainage systems, local detention within the need area, and off-site detention. Increasing the pipe size of the main trunk line would improve conditions of all the inadequate storm sewer systems within the need area. Local detention within the need area is limited to street detention and minimal right-of-way due to the need area being highly residential. Off-site detention was not a feasible option due to the need site being located in a high area bounded along the west, north, and east sides by major ditches.

Tree Impact

The study area contains a number of well-established trees located within the median, and outside of the right-of-way. There are several trees whose canopies extend over the existing roadway that must be trimmed and pruned to provide adequate vertical and horizontal clearances. There are no trees within the parkway portions of the right-of-way; however, there are a few instances where mature trees are close enough to the right-of-way to cause sections of the sidewalks to heave and become uneven.

Traffic

An intersection capacity analysis was performed which identified existing deficiencies and provided recommendations for improvements for the following intersections:

1) W. Fuqua Street at Fondren Road (Signal Control),
2) W. Fuqua Street at Hillcroft Ave (Signal Control),
3) W. Fuqua Street at Blueridge Road (Signal Control),
4) W. Fuqua Street at Ridgerock Road, (All-way **STOP**),

5) W. Fuqua Street at Chimney Rock Road (Signal Control),
6) W. Fuqua Street at W. Ridgecreek Drive (All-way **STOP**).

This study focused on the following three (3) scenarios:

Scenario-1, 2013 Existing Conditions

Scenario-2, 2035 Future Conditions

Scenario-3, 2035 Future Conditions with Mitigation Measures at the Impacted Intersections.

A complete discussion of the analysis can be found in Appendix G.

Table 5. Intersection LOS Analysis – 2013 Conditions

Cross Street	AM Peak LOS	PM Peak LOS
Fondren	C	B
Hilcroft	B	B
Blueridge	B	B
Ridgerock	A	A
Chimney Rock	B	B
Ridgecreek	B	B

Based on current traffic and intersection turning movement counts, the W. Fuqua corridor is presently operating at a Level of Service (LOS) "C". Each intersection was analyzed to determine its LOS using existing signal timing. The 2013 LOS of each intersection is listed in Table 5:

Based on projected traffic counts on W. Fuqua provided by the City, growth factors were calculated in order to determine projected turning movement counts for the above intersections for the 2035 future condition. Using

Based on 2035 projected traffic and intersection turning movement counts, the W. Fuqua corridor is projected to operate at a LOS "D". The 2035 LOS of each intersection is listed in Table 6:

Table 6. Intersection LOS Analysis – 2035 Conditions

Cross Street	AM Peak LOS	PM Peak LOS
Fondren	F	F
Hilcroft	B	B
Blueridge	B	B
Ridgerock	B	C
Chimney Rock	C	C
Ridgecreek	C	F

Alternatives were identified that would improve the LOS that fall below the recommended LOC "C".

These alternatives include:

1) Provide a dual left-turn lane on eastbound W. Fuqua and an exclusive right turn lane on southbound Fondren.
2) Provide an exclusive left turn lane on eastbound W. Fuqua.
3) Convert the All-way STOP at Ridgecreek to a signalized intersection.

A third analysis was performed, incorporating the above alternatives. This improved operations of the W. Fuqua corridor to a LOS "D". The 2035 LOS with improvements for each intersection is listed in Table 7:

Table 7. Intersection LOS Analysis – 2035w/ Improved Conditions

Cross Street	AM Peak LOS	PM Peak LOS
Fondren	D	D
Hilcroft	B	B
Blueridge	B	B
Ridgerock	B	C
Chimney Rock	C	C
Ridgecreek	B	B

The suggested improvements can be completed within the existing right-of-way on W. Fuqua. Additional ROW may be required for the dedicated right turn lane on southbound Fondren. There is sufficient width in the existing median to accommodate the dual left turn lane on eastbound W. Fuqua at Fondren

5. *Alternative Analysis*

Based on the traffic evaluation, data provided by the COH, and data collected from field visits, four alternative solutions were developed for W. Fuqua. The alternatives were grouped based on the extent of the work proposed and the cost of improvements. W. Fuqua was constructed in the 1970's. Paving standards have been revised and elements were added over the years. These changes have been taken into consideration in developing the alternatives e.g. Bicycle routes, ADA compliant ramps and other pedestrian circulation elements to bring the existing one to be fully functional and up to standards. These elements and more are focused on because of the presence of residential units, commercial and retail facilities along the area of study, churches, a public library, and the presence of 3 schools.

Placing the new 24" water main was taken into consideration as indicated by The COH in developing the following alternatives. The location of the proposed water main is dependent upon the locations of other utility lines; we suggest the new water main will be placed in the median. Median placement is the median is the most cost effective choice. If the COH has a decided to place the water main in a different location then alternative A will include more work than it is suggesting below.

PROPOSED ALTERNATIVES

A. Pavement and Sidewalks

For study purpose, the roadway was analyzed as one segment.

Alternative A: The first alternative was developed considering localized repairs for pavement deficiencies by replacing the whole concrete panel (12x80 ft.) wherever pavement damage exists as shown in Exhibit 6. These damages include but not limited to the following: potholes, damaged expansion joints (joint distress, heaving), transverse cracks, pattern cracking, surface distress, and irregular pavement repairs. (From field assessment at least 44 uniform 12x80ft pavement panels need replacement, 20% of the total length of gutter curb need replacement which equals 0.54 mile) As for pedestrian circulation improvement; we suggest replacing damaged areas of sidewalks, adding missing sections of sidewalks specially from Hillcroft to COH Limits on South bound to make it a continuous, functional circulation system, relocating sidewalk away from manholes, and adding ADA ramps where needed to make the circulation system more accessible and up to standards.

Alternative B: The second alternative includes a wider extent of work. We suggest rebuilding the roadway with the existing section (2 lanes 12 ft. each in each direction, with 32 ft. median, and 5 ft. sidewalks on each side) see Exhibit 4.1. The new roadway will extend from COH limits to Chimney Rock Street.
For the pedestrian circulation, the rebuilding of continuous sidewalks ADA compliant, 5ft wide with ramps is suggested.

Alternative C: This alternative was developed to include full upgrade to the road section, median and pedestrian circulation. The suggested alternative is by rebuilding the roadway with

a new section that is 28 ft. wide, two lanes 15 ft. to provide shared use with bicycles and 13ft lane, on both directions. The suggested road widening will not affect the right-of-way; it will rather take the extra width from the medians. This will narrow down the median from 32 ft. to 24 ft. (See Exhibit 4.2) Pedestrian circulation will be improved by the rebuilding of continuous sidewalks ADA compliant, 5 ft. wide.

Alternative D: This alternative was developed to address the inadequacy of the existing drainage systems within the study area. The proposed is solution provides a separate drainage system that runs along W. Fuqua from Ruppstock to the Sims Bayou tributary outfall east of Bazel Brook. Analysis of this alternative indicated that similar roadway improvements are required between Chimney Rock and Bazel Brook.
The Roadway and Traffic element for this alternative inclused rebuilding the roadway with the existing road sections. The road segment from Bazel Brook to Beltway 8 was recently reconstructed. This alternative will integrate the (COH limit to Bazel Brook) to the above mentioned reconstructed segment, wish will make the entire roadway in the study area function witnin the same lvel of efficiency.

B. Drainage

Alternative I: Upgrade and repair curbs and inlets
This alternative correlates with roadway Alternative A which includes repairing cracked and damaged pavement at inlets, repairing cracked and damaged curb, and providing curb at locations where curb is missing, in order to allow the stormwater to efficiently flow into the inlet structures. Proper repair of the adjacent pavement will improve the function of the inlets.

Alternative II: Rebuild drainage to provide in-line storage (existing roadway section)

This alternative involves upgrading the existing storm sewer system to provide in-line detention for the design storm using the existing roadway section for W. Fuqua Street. All inadequate storm sewer segments were upgraded with larger pipe sizes to improve capacity and conveyance for the 2-year storm. The extreme event was imposed on the upgraded system and analyzed for local detention within the right-of-way.

The method used for determining local detention of the extreme event flow was by comparing the Hydraulic Grade Line (HGL) elevation to the critical elevation, in this case, the ground elevation at the right-of-way. If the HGL was lower than the critical elevation, then the system was determined to be adequate for detaining the extreme event flows locally. If the HGL was higher than the critical elevation, then the system was determined to be deficient for detaining the extreme event flows locally. All deficient segments were further upsized to meet the 100-year event criteria (i.e., enough to bring the HGL below the critical elevation).

The hydraulic gradient was calculated assuming the top of the outfall pipe as the starting water surface elevation. At drops in pipe invert, should the upstream pipe be higher than the HGL, then the HGL was recalculated assuming the starting water surface to be at the top of pipe at that point.

Using the downstream starting water elevation as a base, the computed friction loss h_f was added. This resulted in the extreme event HGL elevation. The extreme event HGL elevation was compared with the elevation represented by uniform depth of flow plus the upstream flowline elevation of the subject conduit. The higher of the two elevations was the controlling HGL elevation at the upstream node of the conduit run.

The drainage area, peak flow, drainage system capacity, and extreme event analysis and upgrades are presented in **APPENDIX F, Table 2. Need Area Drainage Systems Calculations (with Improvements).** To summarize, Systems A and B were sufficient in conveying the 2-year storm and adequate for detaining the extreme event flows within the right-of-way. Systems C through G required larger pipe sizes in order to convey the 2-year storm and provide local detention of the extreme event flows. The improvements are illustrated in **EXHIBIT 12B EXISTING STORMWATER DRAINAGE SYSTEMS WITH IMPROVEMENTS (ALT. B & C).**

Alternative III: Rebuild drainage to provide in-line storage (widened roadway section)

This alternative involves upgrading the existing storm sewer system to provide in-line detention for the design storm using a widened roadway section which accommodates shared-use lanes for bicycles in both directions. Along with additional left-turn storage length in some areas, this alternative increases the amount of impervious area.

The amount of added impervious area was calculated to be approximately 1.47 acres. The mitigation rate of 0.5 ac-ft of mitigation per acre of added impervious area was used. This resulted in 0.73 ac-ft required for mitigation. Due to the increase in pipe sizes to improve capacity and conveyance of the existing system discussed in Alternative 2 above, an increase in storage was added to the upgraded storm sewer system. The total net storage due to the upgrade of existing storm sewers was determined to be 1.338 ac-ft, which exceeds the mitigation requirements. The calculations for determining additional net storage can be found in **APPENDIX F, Table 3. Added Net Storage with Improvements.**

Alternative IV: Extend drainage to Sims Bayou with separate system for W. Fuqua Street

This alternative involves separating the W. Fuqua Street portion of the drainage systems, and making it its own system extending to the east with outfall to Sims Bayou. This system includes the W. Fuqua Street drainage areas from Ruppstock Road to the east, ending prior to the Harris/Fort Bend county line. For this alternative, we are assuming that System A which drains a portion of W. Fuqua Street and Fondren Road will continue to drain to the north, and Systems B and C will drain to the ditch along Hillcroft Avenue, with upgrades from Alternative 2 applied to System C. The W. Fuqua Street system is designed for capacity and conveyance of the 2-year storm. The extreme event was imposed on the system and analyzed for local detention within the right-of-way, in the same manner as for Drainage Alternative II and III. The drainage area, peak flow, drainage system capacity, and extreme event analysis are presented in **APPENDIX F, Table 4. Need Area Drainage Systems Calculations (W. Fuqua Street)**, and is illustrated in **EXHIBIT 13 STORMWATER DRAINAGE SYSTEM FOR W. FUQUA STREET (ALT. D).**

C. Public Utilities

Water

The City provided recommendations for water main improvements within the study area based on the age and capacity of the existing line. This recommendation proposed to replace the existing 16-inchmain with a 24-inch main. The 24" main would likely be located within the median; this would allow the new line to be constructed in its entirety regardless of the roadway alternative recommendation. See (Exhibit 14)

Wastewater

The City also provided recommendations for sanitary sewer improvements. Information provided by the City indicated the system along W. Fuqua is currently operating under capacity. Based on the relatively good condition of the system, and the City's program to reduce or eliminate back lot collection system, the City has requested the installation of a 10-inch stub to run to the north side of the Ridgerock intersection as a tie to a future project. This modification can also be constructed regardless of the recommended alternative.

6. *Study Area Challenges*

A. Real Estate Acquisition

Based on the investigation we conducted, no additional right-of- way is required for the improvements and alternatives developed by Omega Engineers.

B. Construction Traffic Control

It is anticipated the roadway and utility reconstruction will be completed for one half of the pavement section at a time. Two-way traffic will be maintained throughout the construction area. Pavement removal will be limited to minimize impacts on business, schools, residents' road users, and bus routes.
Advisory and directional/detour signs will be also used to divert traffic to adjacent streets.
Coordination with Schools, Churches, businesses and public services will be required during the final design and construction phases in order to minimize traffic impacts during peak hours.

C. Tree Impact

There is a significant number of trees in the median which could be a potential challenge especially if the median width is reduced. Omega Engineers recommends the engagement of an urban forester during final design services to review the construction plans for impacts to the existing trees and to prepare a tree preservation and mitigation plan. Also, appropriate tree protection and responsible tree trimming will help minimize the impacts of construction on the trees. The use of smaller, lighter-duty construction equipment, where possible, will also help to lessen the impacts of the construction activities on the existing trees.

D. Metro

Coordination with Metro will be required during final design and construction phase to minimize interruption of the bus services.

E. On-Street Parking

On-Street parking might be one of the biggest challenges facing the construction and future traffic if it remains uncontrolled. It is common near residential properties of both directions of the road. Also, it was noticed from field visits multiple vehicles parking on houses driveways all the way to the street which interrupt pedestrian circulation. Parking restrictions should be considered temporarily during construction, or permanently to improve local mobility

F. Permits and License

1) Storm Water Pollution Protection (SW3P)

A SW3P Plan will be developed in accordance with Texas Pollutant Discharge Elimination System (TPDES) requirements. As stated in the Texas General permit TXR 150000, issued by the Texas Commission on Environmental Quality (TCEQ), a TPDES permit is required for the construction activity if the total disturbed area is equal to or more than one acre. The proposed construction activity related to the improvement of W. Fuqua Street is expected to disturb More than one Acre of land area. Therefore, the Contractor will be required to apply for TPDES permit through a Notice of Intent (NOI) sent to TCEQ regional office, TPDES Permit Division prior to start of construction. The Contractor will be responsible for implementation, maintenance and inspection of storm water pollution prevention control measures including, but not limited to source controls for erosion and sedimentation controls, waste collection and disposal, filter fabric fence, reinforced filter fabric barrier, stabilized construction exit and other practices.

2) Architectural Barriers Act (ABA)

Construction drawings will be submitted to a private consultant approved by Texas Department of Licensing and Regulation (TDLR) for compliance with the Architectural Barriers Act (ABA).

3) COH Permits

Permits will be required from COH for construction of proposed improvements within the W. Fuqua corridor. These permits include road / lane closure permits, traffic control permits, and street cut permits.

4) Environmental And Cultural Investigations

As part of Final Design, an Environmental Site Assessment (ESA), based on the procedures established by the COH Guidelines for performing Environmental Site Assessments, will be performed. The report will contain detailed descriptions of the study performed and the conclusions reached in regard to the proposed construction of pavement, drainage, and utility improvements in the need area, relating to wetlands, endangered species, and known cultural resources in the proposed right-of-way. Determination of required permits from the US Army Corps of Engineers and the Texas Historical Commission will also be made.

5) Geotechnical Investigation

As part of Final Design, a geotechnical investigation will be performed, and recommendations will be made pertaining to the soils found in the need area relating to the design of pavement sections and trench safety.

7. Recommendations

In developing the Candidate project, each alternative was analyzed in terms of project scope, overall estimated cost and Candidate Project Priority Score. Candidate Priority Scores for each of the alternatives are as follows:

Improvement Alternatives Summery		
Alternative	Cost	Priority Score
Alternative A	N/A	N/A
Alternative B	$21.07 mil	43.45
Alternative C	$21.56 mil	41.53
Alternative D	$21.76 mil	48.91

Alternative A has been eliminated from further consideration because it does not involve a total rebuild of the infrastructure within the study area. This factor would reduce the overall cost effectiveness of the project due to its reduced design life.

A fifth alternative (E) was also considered. This alternative would be similar to Alternative D with the widened section used in Alternative C. This alternative was not developed further due to the lack of connectivity to or existing or proposed bicycle routes in the area. Additionally, the widened section would not correspond to the section of W. Fuqua between Bazel Brook and Beltway 8 which has recently been rebuilt.

A. Recommended Project

Once Alternative A is eliminated, Alternative D becomes the highest scoring alternative. Therefore, Alternative D is recommended for further development as the Candidate Project for Need Area NT R1.

This alternative is also the most logical for further development. As stated above, tie proposed roadway section would match what was used for the previously reconstructed portion of W. Fuqua between Bazel Brook and the Beltway. It would reconstruct the remaining portion of W. Fuqua between the city limits and the Beltway.

Alternative D would address storm sewer capacity issues for the systems within the Briargate subdivision by diverting runoff within the W. Fuqua drainage area further to the east. This would also provide added capacity to the drainage channel which serves as an outfall for the Briargate subdivision drainage systems, because of the reduced Q's within those systems.

B. Probable Construction Cost for Recommended Project

The construction cost estimate for each alternative was developed based on proposed improvements using unit costs provided by the City. Total Project Costs were developed based on anticipated roadway, drainage, and water and wastewater estimated quantities, as well as calculated engineering design, and engineering and construction management costs. The estimated total project cost for Alternative D is $21.75 million.

APPENDIX

APPENDIX A

VICINITY MAPS

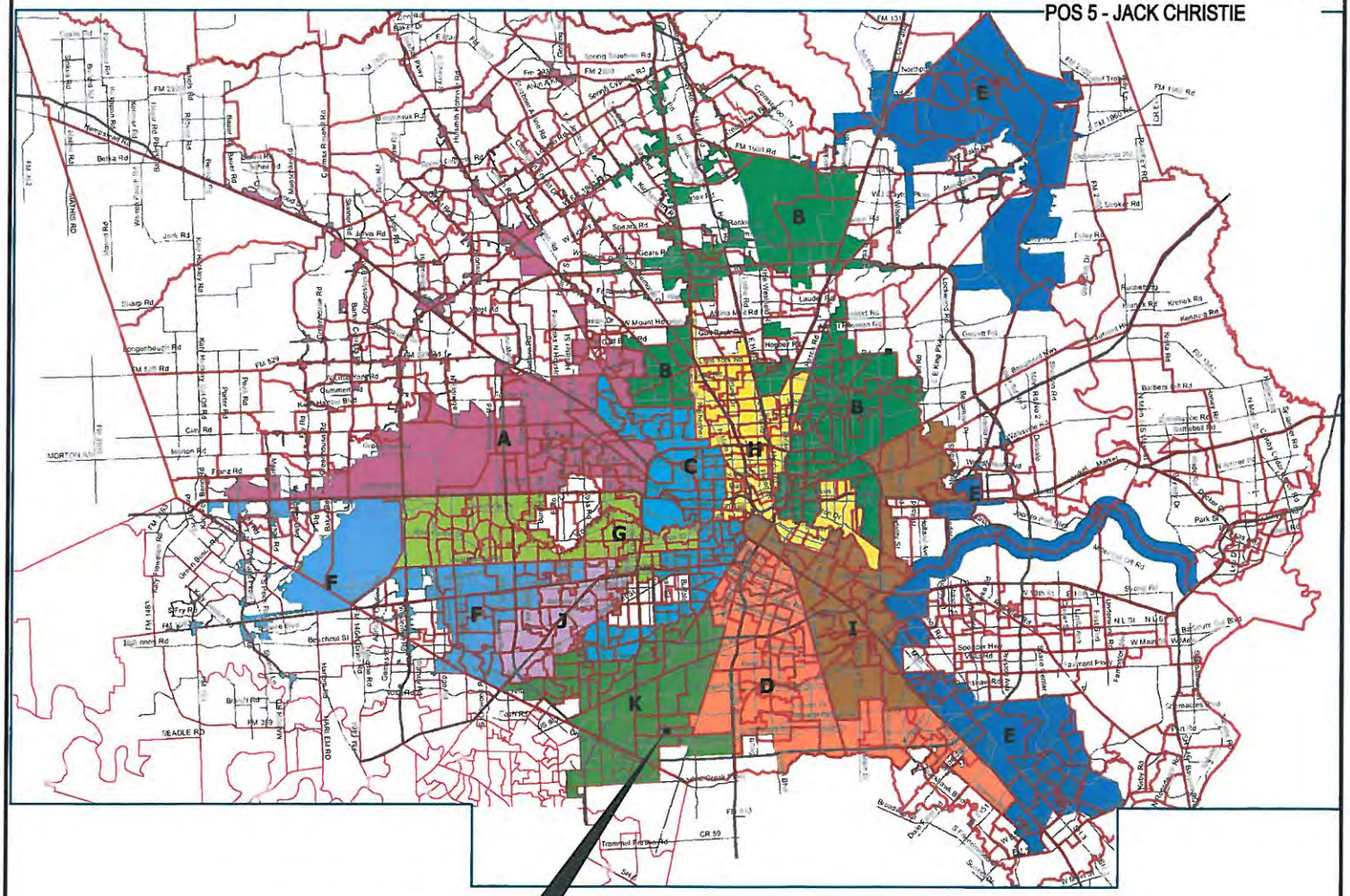
N

COUNCIL DISTRICTS

A - HELENA BROWN
B - JERRY DAVIS
C - ELLEN COHEN
D - WANDA ADAMS
E - DAVE MARTIN
F - AL HOANG
G - OLIVER PENNINGTON
H - ED GONZALEZ
I - JAMES G. RODRIGUEZ
J - MIKE LASTER
K - LARRY GREEN

AT LARGE

POS 1 - STEPHEN C. COSTELLO
POS 2 - ANDREW C. BURKS, JR.
POS 3 - MELISSA NORIEGA
POS 4 - C.O. "BRAD" BRADFORD
POS 5 - JACK CHRISTIE



PROJECT LOCATION

N.T.S.

CITY OF HOUSTON

DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

PAVING AND DRAINAGE IMPROVEMENTS
INFRASTRUCTURE PLANNING

W. FUQUA CHIMNEY ROCK
TO MISSOURI CITY LIMITS

OMEGA ENGINEERS, INC.
16420 Park Ten Place Suite 520 Houston, Texas 77084
Tel 281-647-9182 Fax 281-647-9184

VICINITY MAP

Legend: Places of Interest
1- Spanish Assemblies of God Church
2- Water Treatmeant Plant
3- Valero Gas Station
4- Retail and Commercial Businesses
5- Stimley-Blue Ridge Library
6- Briargate Head Start School
7- Citgo Gas Station
8- Southern Preparatory Academy
9- The Living Word Faith Center
10- Fondren Seventh Day Adventist Church
11- Abiding FaithBaptist Church

PAVING AND DRAINAGE IMPROVEMENTS
NEED AREA 01: WEST FUQUA STREET
MISSOURI CITY LIMITS TO CHIMNEY ROCK ROAD

Exhibit 01

West Fuqua Street
Overall Layout

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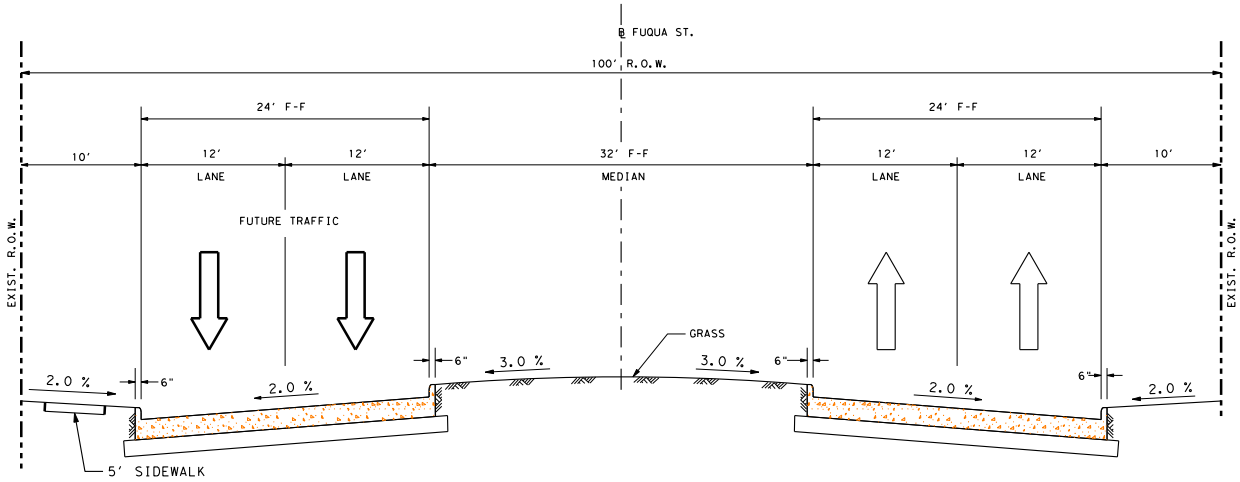
APPENDIX B

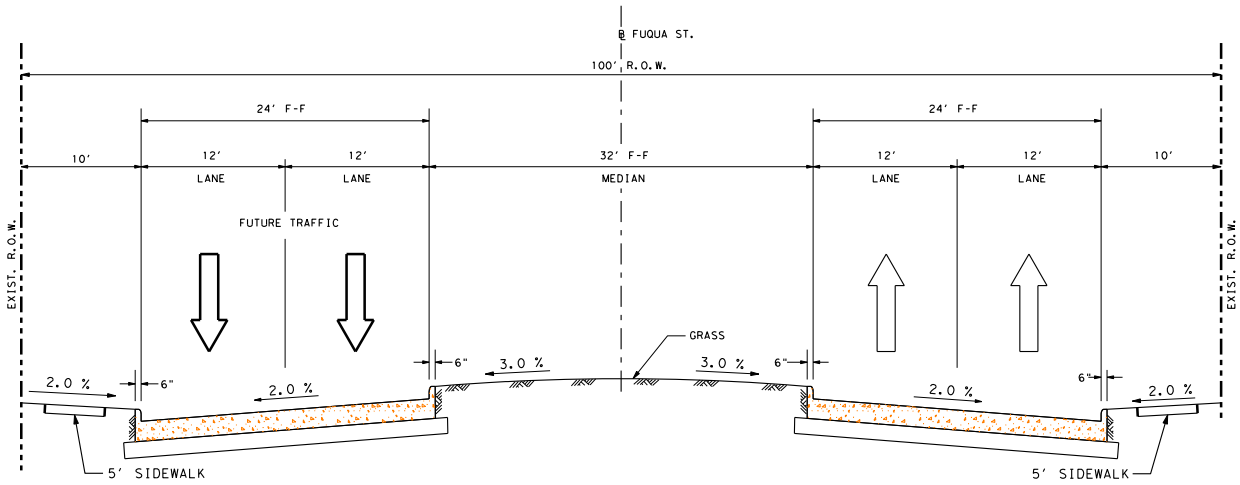
TYPICAL SECTIONS



3.1 EXISTING TYPICAL SECTION

N.T.S.

FROM COH LIMITS TO HILLCROFT RD.



3.2 EXISTING TYPICAL SECTION

N.T.S.

FROM HILCROFT RD.. TO BAZEL BROOK DR.

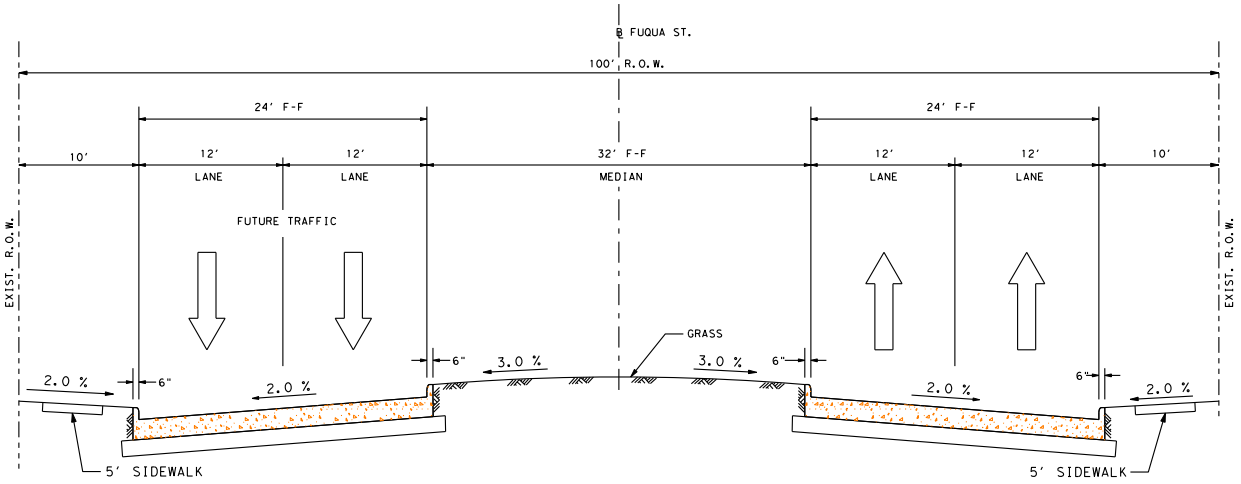
OMEGA ENGINEERS INC.
16420 Park Ten Place, SUITE 520
Houston, Texas 77084
Tel 281-647-9182
Fax 281-647-9184
TX. REG. No. F-2147

DRN BY	DATE
DRN CKD BY	DATE
DES BY	DATE
DES CKD BY	DATE
APPROVED BY	DATE
SCALE:	

EXHIBIT 3 (1 and 2)

EXISTING TYPICAL SECTIONS

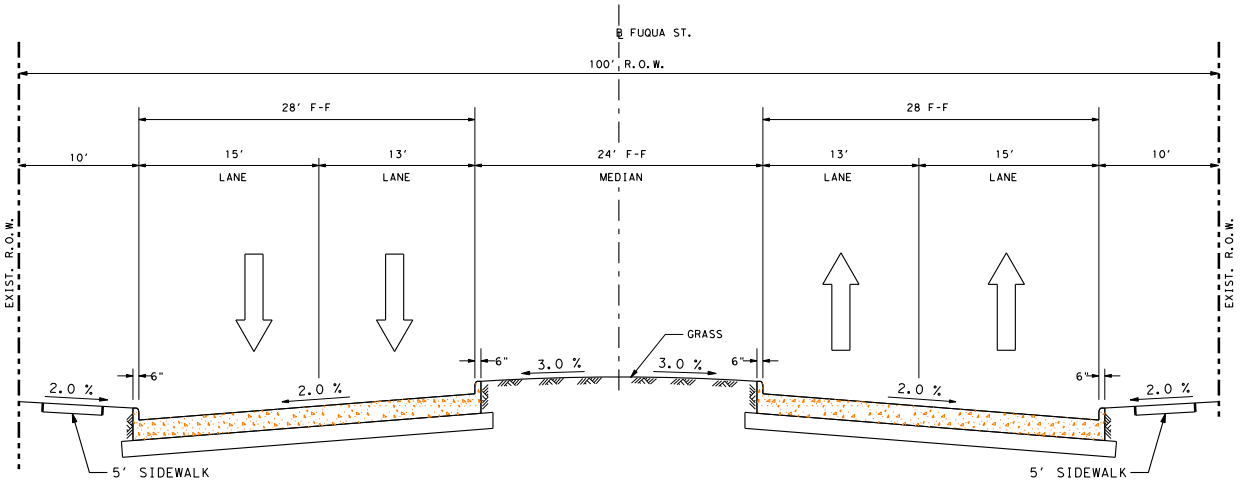
CONTRACT NO.	DRAWING NO.	REV.



PROPOSAL TYPICAL SECTION

N.T.S.

4.1 ALTERNATIVE B



PROPOSED TYPICAL SECTION

N.T.S.

4.2 ALTERNATIVE C

OMEGA ENGINEERS INC.
16420 Park Ten Place, SUITE 520
Houston, Texas 77084
Tel 281-647-9182
Fax 281-647-9184
TX. REG. No. F-2147

DRN BY	DATE
DRN CKD BY	DATE
DES BY	DATE
DES CKD BY	DATE
APPROVED BY	DATE
SCALE:	

EXHIBIT 4 (1 and 2)

PROPOSED TYPICAL SECTIONS

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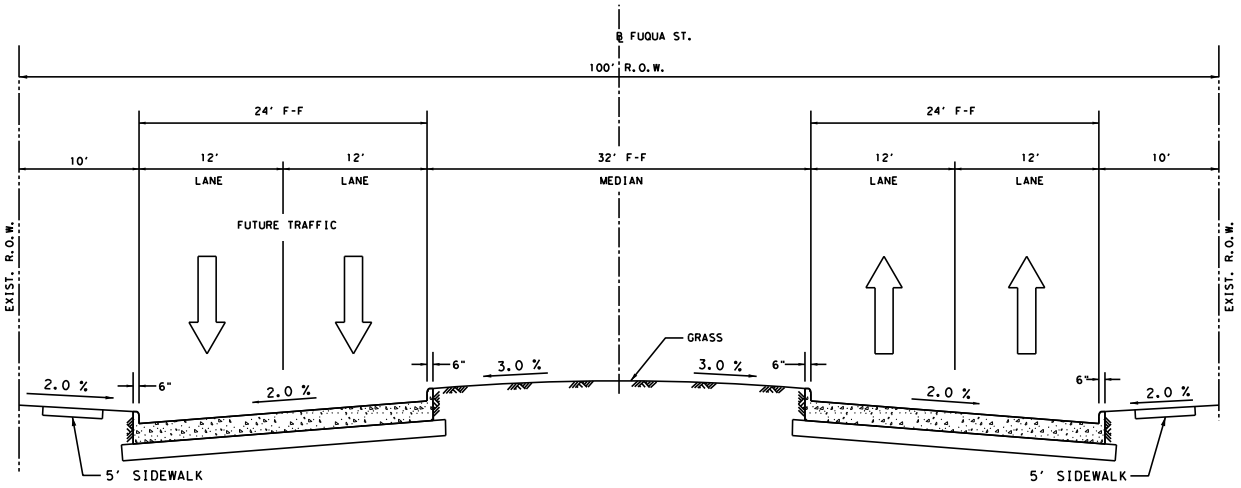


PROPOSAL TYPICAL SECTION

N.T.S.

ALTERNATIVE D

OMEGA ENGINEERS INC.
16420 Park Ten Place, SUITE 520
Houston, Texas 77084
Tel 281-647-9182
Fax 281-647-9184
TX. REG. No. F-2147

DRN BY	DATE
DRN CKD BY	DATE
DES BY	DATE
DES CKD BY	DATE
APPROVED BY	DATE
SCALE:	

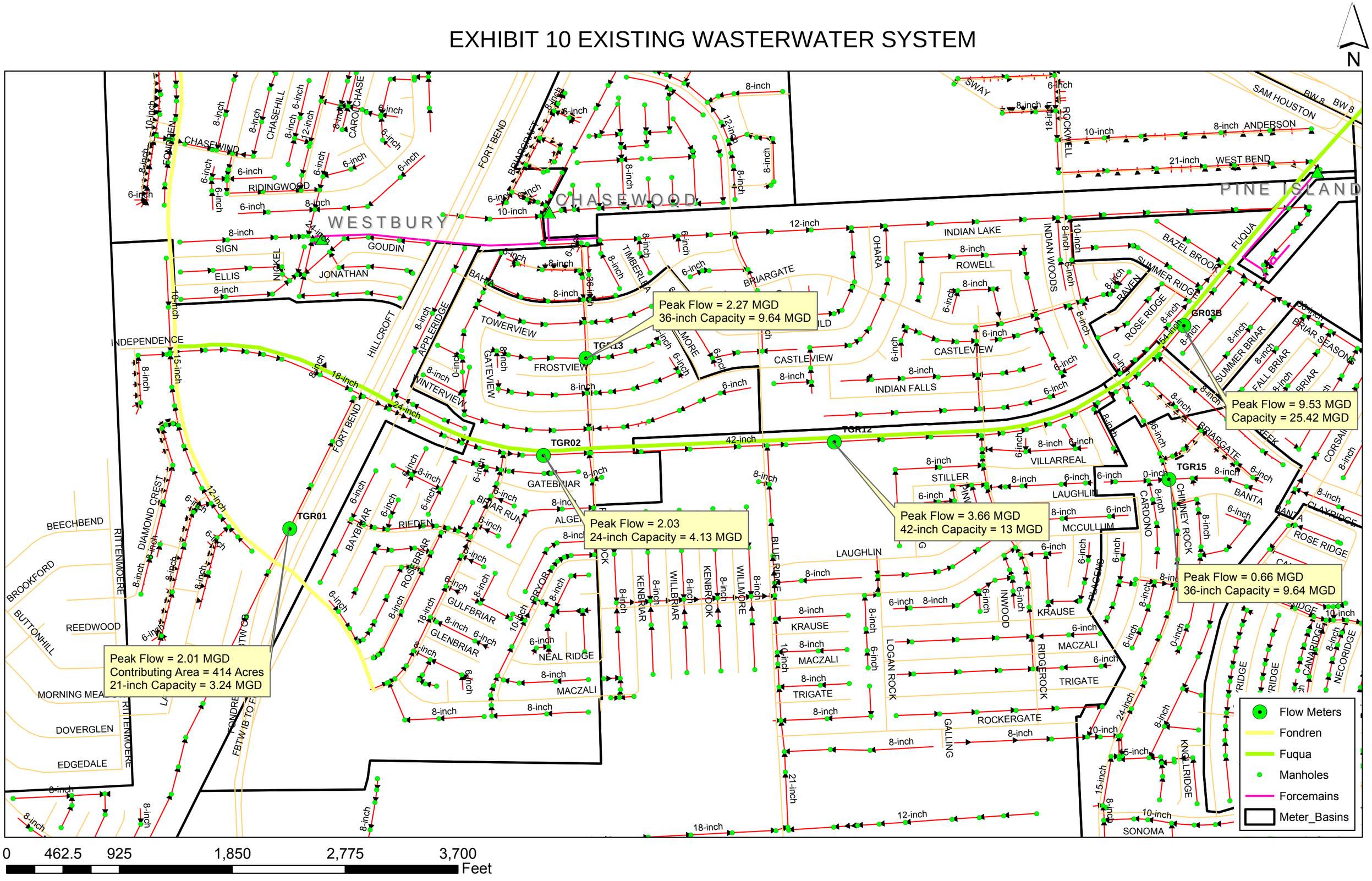
EXHIBIT No. 5
PROPOSED TYPICAL SECTION
ALTERNATIVE D

CONTRACT NO.	DRAWING NO.	REV.

APPENDIX D

EXISTING AND PROPOSED UTILITIES AND DRAINAGE

EXHIBIT 10 EXISTING WASTERWATER SYSTEM



EXIHIBIT 11 PROPOSED WASTEWATER SYSTEM

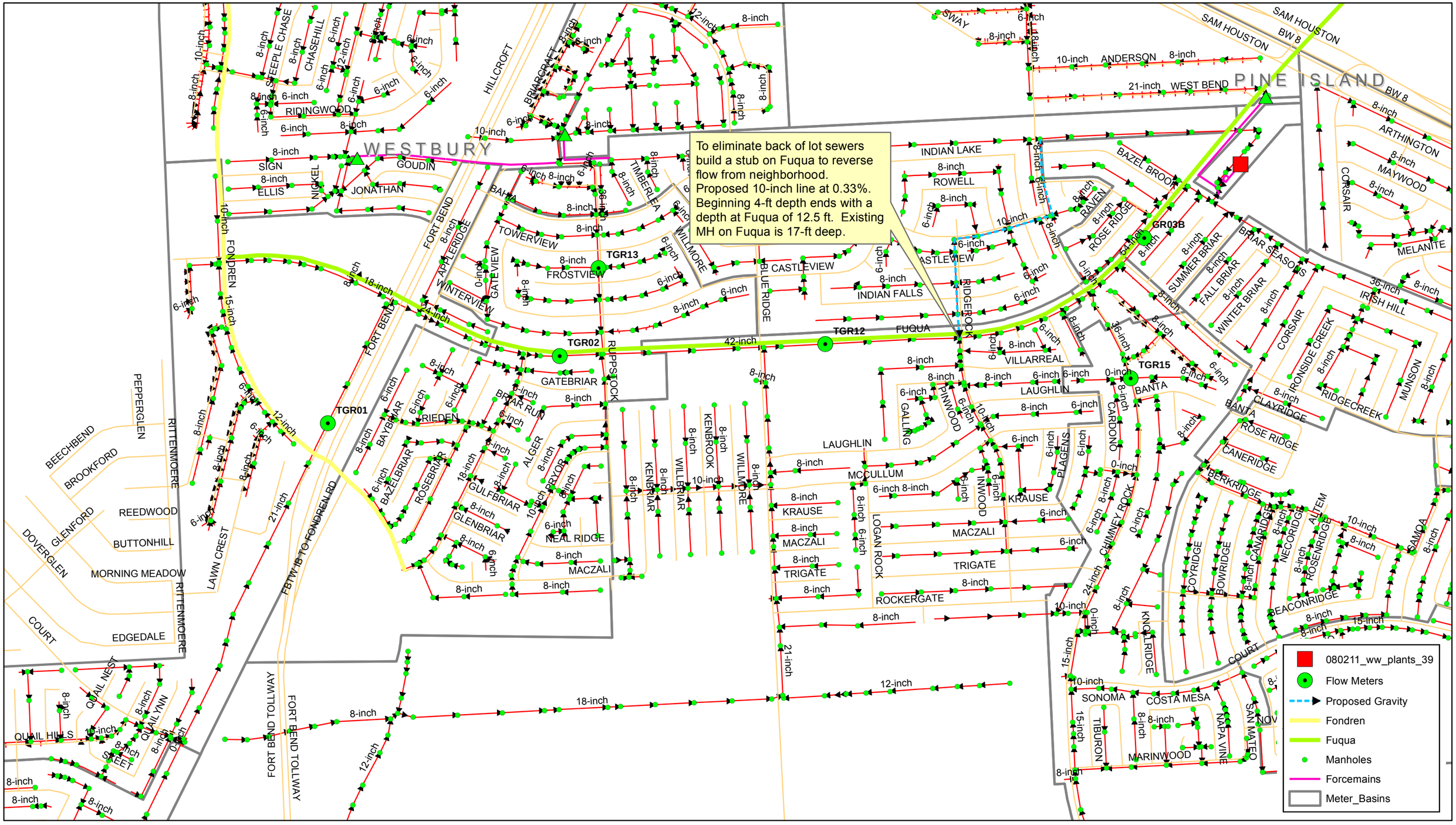
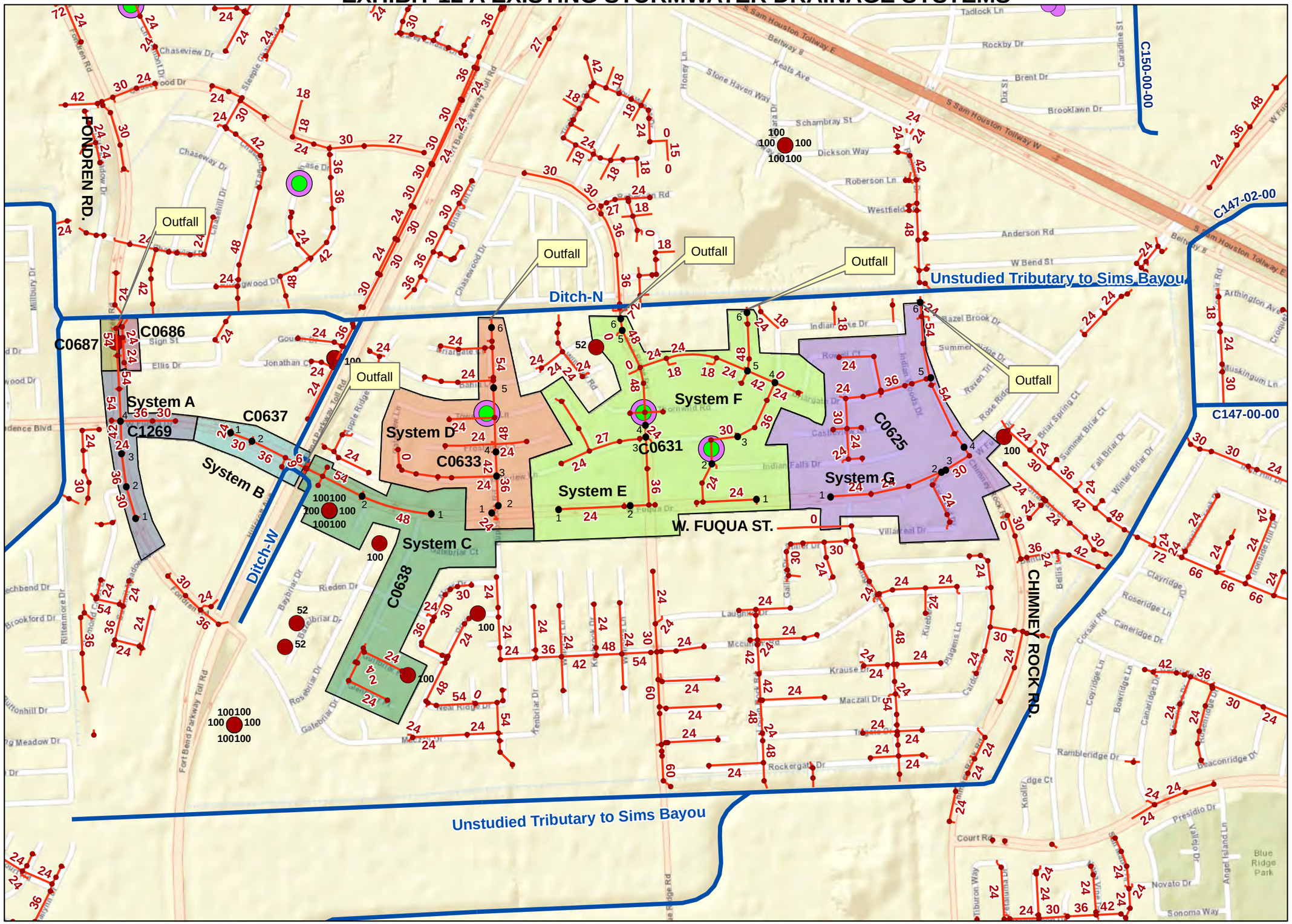


EXHIBIT 12 A EXISTING STORMWATER DRAINAGE SYSTEMS



Legend

- Streams
- Storm Sewers
- 311_flood_2002-2010
- FEMA Repetative Losses
- FEMA_repetativelosses_fulldata

Drainage Areas

Outfalls

- C0625
- C0631
- C0633
- C0637
- C0638
- C0686
- C0687
- C1269
- C1275

FEMA Flood_Zones

FLD_ZONE

- 500 yr
- A
- 100 yr
- AO
- VE
- Manhole

Notes:

* Outfalls to Sims Bayou (approximately 250 acres)

* Outside 100 & 500 yr Flood Zones

* Three (3) Oil & Gas Pipelines Cross Project

0 320 640 1,280 Feet

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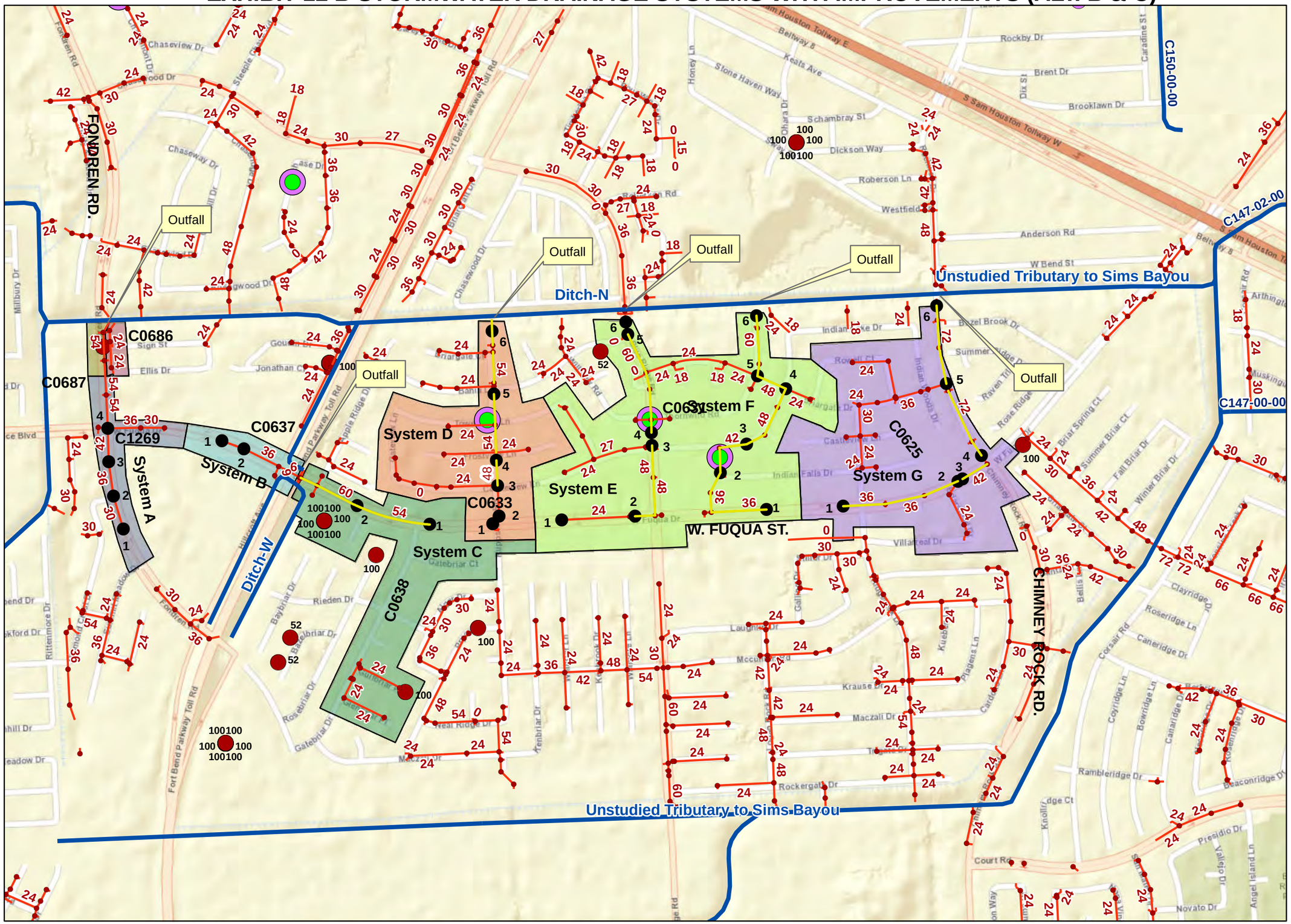
EXHIBIT 12 B STORMWATER DRAINAGE SYSTEMS WITH IMPROVEMENTS (ALT. B & C)



Legend

- Proposed Storm Sewer
- Manhole
- Manhole Included in the Study
- Streams
- Storm Sewers
- 311_flood_2002-2010
- FEMA Repetative Losses
- FEMA_repetativelosses_fulldata

Drainage Areas

Outfalls

- C0625
- C0631
- C0633
- C0637
- C0638
- C0686
- C0687
- C1269
- C1275

FEMA Flood_Zones

FLD_ZONE

- 500 yr
- A
- 100 yr
- AO
- VE

Notes:

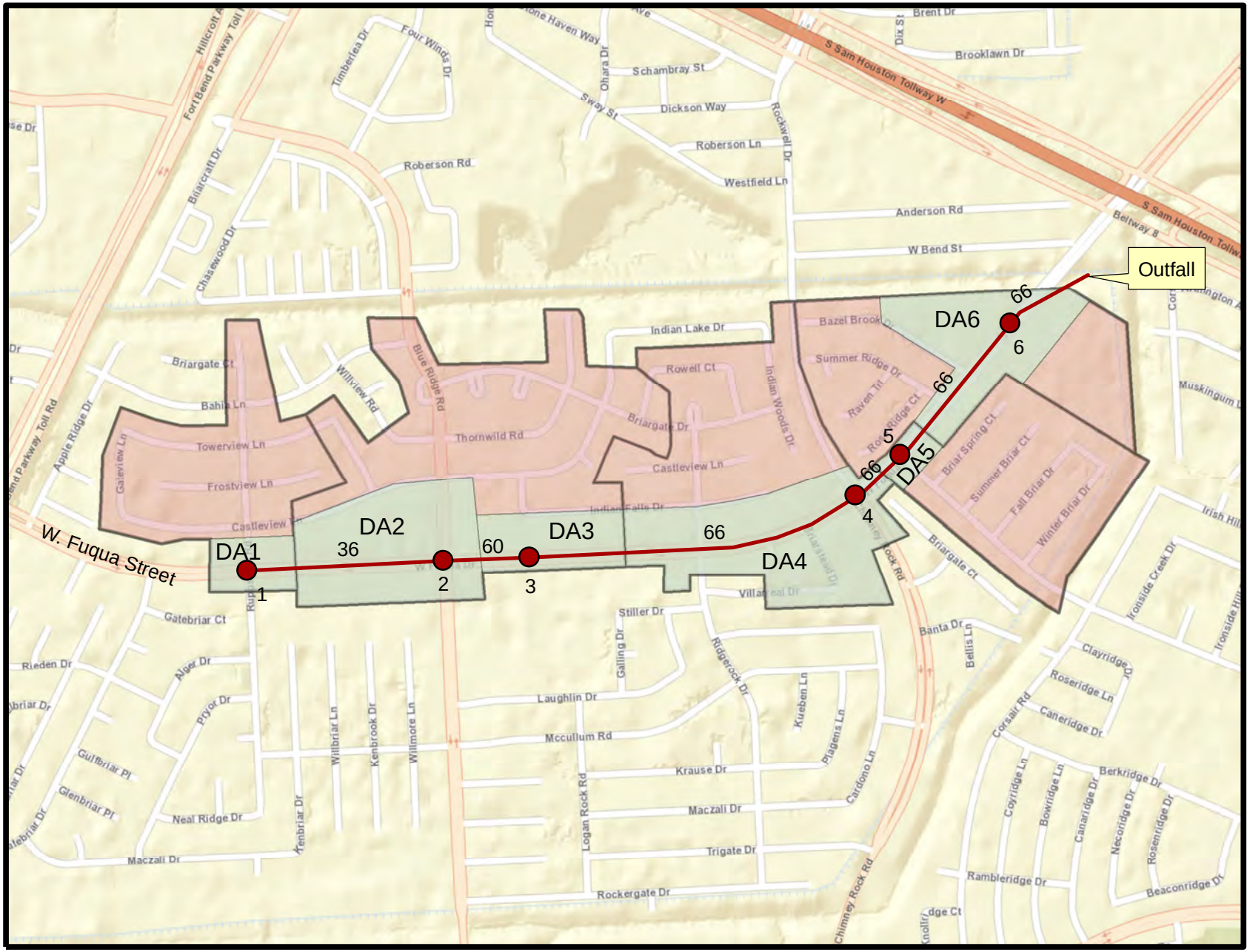
* Outfalls to Sims Bayou (approximately 250 acres)

* Outside 100 & 500 yr Flood Zones

* Three (3) Oil & Gas Pipelines Cross Project

0 310 620 1,240 Feet

OMEGA ENGINEERS, INC.
Engineering & Construction Management Company



Drainage Area ID	Area Size (ac)
1	4.01
2	17.42
3	8.30
4	21.63
5	2.63
6	18.03

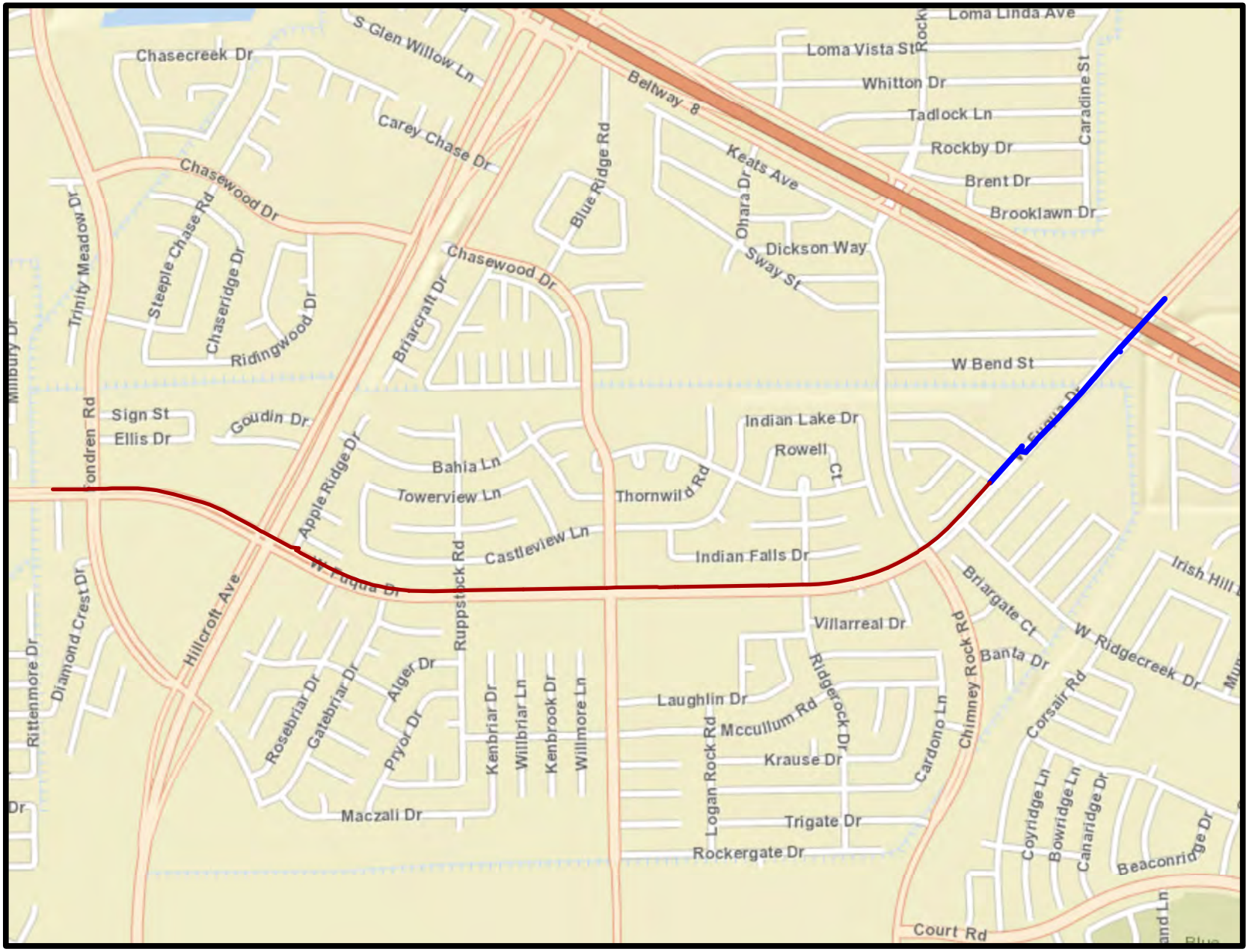
Stormwater Drainage System for W. Fuqua Street (Alt. D)
Exhibit 13

N
W E
S

0 625 1,250 2,500 Feet

Legend

- Proposed Manhole
- Proposed Drainage Sewer
- Proposed Outfall Drainage Area Alternative D.
- Existing Outfall Drainage Areas



Existing and Proposed Water Main

EXHIBIT 14

N
W E
S

0 230 460 920 Meters

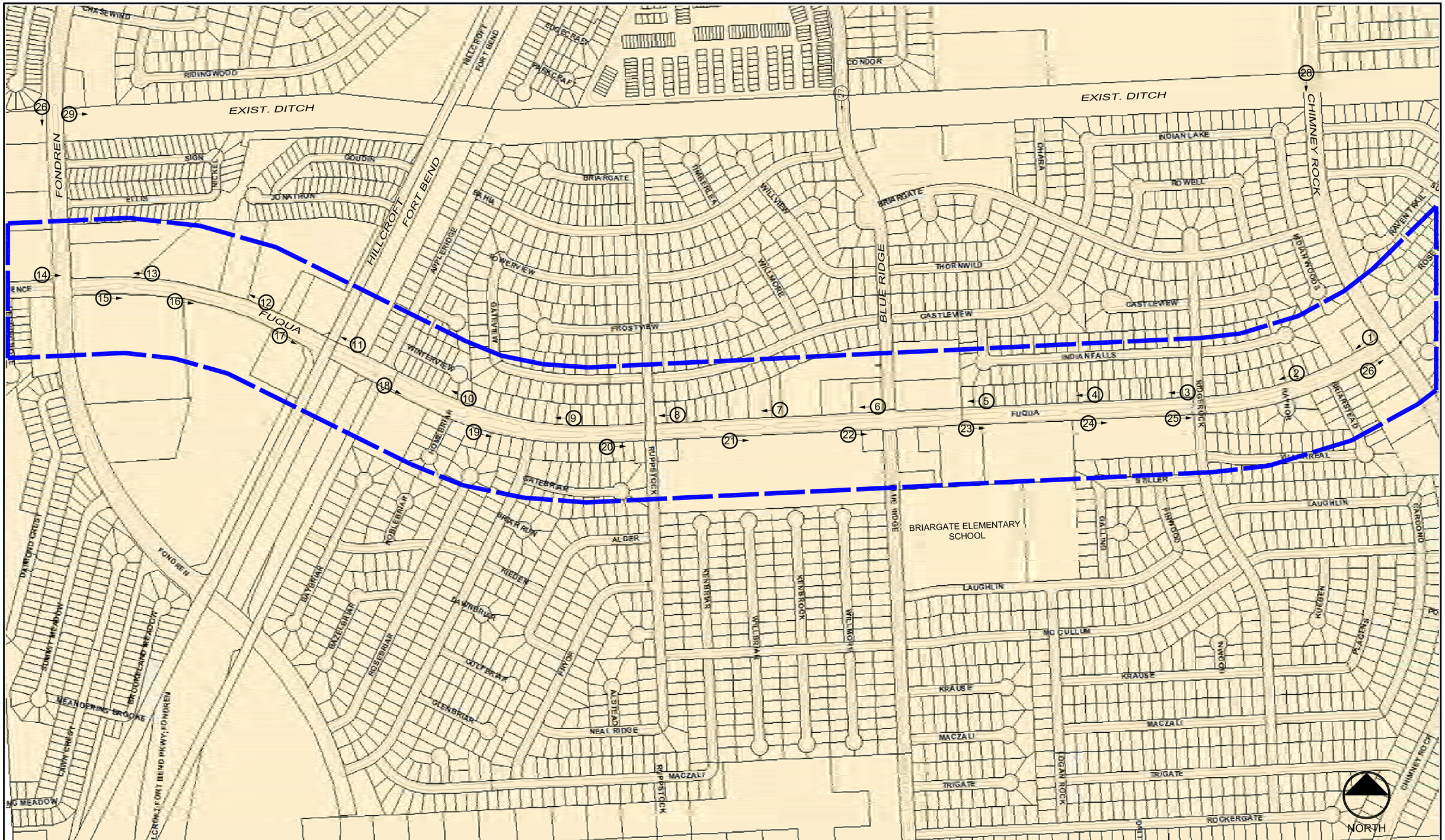
Legend

Existing 16" Water Main to be Replaced by 24" Water Main

Existing 24" Water Main

APPENDIX E

PROJECT PHOTOGRAPHS



LEGEND

1 SEE PHOTO NUMBER

PROJECT LIMITS

REV	DATE	DESCRIPTION	ADD	AMD	CCR	BY	ENG	CHK	APP

OMEGA ENGINEERS, INC.
16450 Park Ten Place Suite 520 Houston, Texas 77084
Tel 281-647-9182 Fax 281-647-9184

DRN BY	DATE
DRN CKD BY	DATE
DES BY	DATE
DES CKD BY	DATE
APPROVED BY	DATE
SCALE:	

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

PHOTO LAYOUT A
EXHIBIT

CONTRACT NO. | DRAWING NO. | REV.

PHOTOS LAYOUT A

PHOTO No. 1A FUQUA ST. LOOKING WEST

PHOTO No. 2A FUQUA ST. LOOKING WEST

PHOTO No. 3A FUQUA ST. LOOKING WEST

PHOTO No. 4A FUQUA ST. LOOKING WEST

PHOTO No. 5A FUQUA ST. LOOKING WEST

PHOTO No. 6A FUQUA ST. LOOKING WEST

PHOTO No. 7A FUQUA ST. LOOKING WEST

PHOTO No. 8A FUQUA ST. LOOKING WEST

PHOTO No. 9A FUQUA ST. LOOKING WEST

PHOTO No. 10A FUQUA ST. LOOKING WEST

PHOTO No. 11A FUQUA ST. LOOKING WEST

PHOTO No. 12A FUQUA ST. LOOKING WEST

PHOTO No. 13A FUQUA ST. LOOKING WEST

PHOTO No. 14A FUQUA ST. @ FONDREN LOOKING EAST

PHOTO No. 15A FUQUA ST. LOOKING EAST

PHOTO No. 16A FUQUA ST. LOOKING EAST

PHOTO No. 17A FUQUA ST. LOOKING EAST

PHOTO No. 18A FUQUA ST. @ HILLCROFT AVE. LOOKING EAST

PHOTO No. 19A FUQUA ST. LOOKING EAST

PHOTO No. 20A FUQUA ST. LOOKING EAST

PHOTO No. 21A FUQUA ST. LOOKING EAST

PHOTO No. 22A FUQUA ST. LOOKING EAST

PHOTO No. 23A FUQUA ST. LOOKING EAST

PHOTO No. 24A FUQUA ST. @ RIDGEROCK
LOOKING EAST

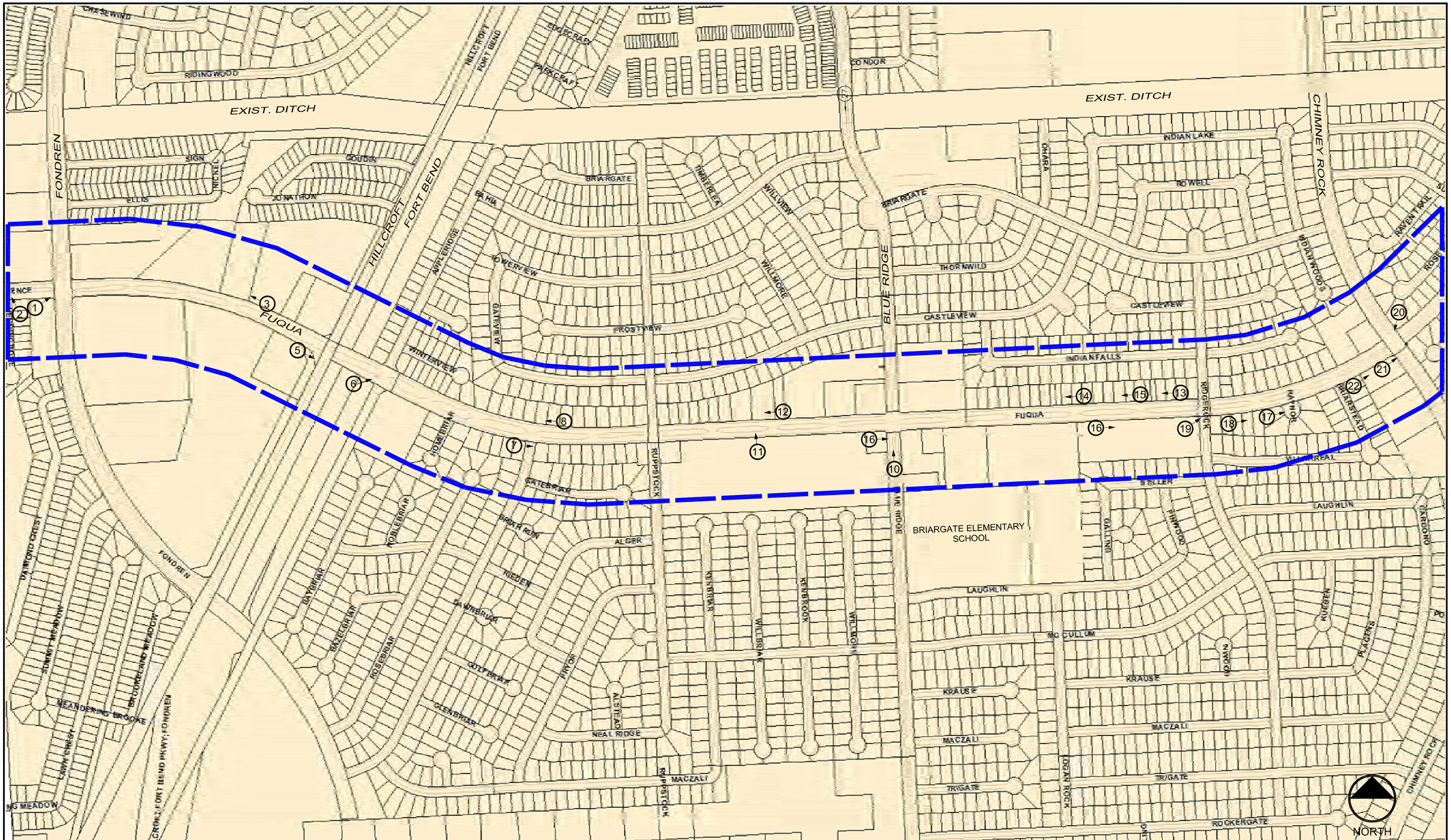
PHOTO No. 25A FUQUA ST. @ CHIMNEY ROCK
LOOKING EAST

PHOTO No. 26A FONDREN OUTFALL (NORTH)
LOOKING SOUTH

PHOTO No. 27A BLUERIDGE OUTFALL (NORTH)
LOOKING SOUTH

PHOTO No. 28A OUTFALL CHIMNEY ROCK (NORTH)
LOOKING SOUTH

PHOTO No. 29A EXISTING DITCH ON NORTH AREA
LOOKING EAST



REV	DATE	DESCRIPTION	ADD	AMD	CCR	BY	ENG	CHK	APP

LEGEND

(1) SEE PHOTO NUMBER

PROJECT LIMITS

OMEGA ENGINEERS, INC.
16450 Park Ten Place Suite 520 Houston, Texas 77084
Tel 281-647-9182 Fax 281-647-9184

DRN BY	DATE
DRN CKD BY	DATE
DES BY	DATE
DES CKD BY	DATE
APPROVED BY	DATE
SCALE:	

CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

PHOTO LAYOUT B
EXHIBIT

CONTRACT NO. | DRAWING NO. | REV.

PHOTOS LAYOUT B

PHOTO No. 1B FUQUA ST. LOOKING WEST

PHOTO No. 2B FUQUA ST. LOOKING EAST

PHOTO No. 3B FUQUA ST. LOOKING EAST

PHOTO No. 5B FUQUA ST.@ FONDREN RD.
LOOKING WEST

PHOTO No. 6B FUQUA ST. LOOKING
NORTH EAST

PHOTO No. 7B FUQUA ST. LOOKING EAST

PHOTO No. 8B FUQUA ST. LOOKING EAST

PHOTO No. 9B FUQUA ST. LOOKING EAST

PHOTO No. 10B FUQUA ST. LOOKING NORTH EAST

PHOTO No. 11B FUQUA ST. LOOKING NORTH

PHOTO No. 12B FUQUA ST. LOOKING WEST

PHOTO No. 13B FUQUA ST. LOOKING SOUTH

PHOTO No. 14B FUQUA ST. LOOKING WEST

PHOTO No. 15B FUQUA ST. LOOKING WEST

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PHOTO No. 17B FUQUA ST. LOOKING EAST

PHOTO No. 18B FUQUA ST. LOOKING EAST

PHOTO No. 19B FUQUA ST. LOOKING EAST

PHOTO No. 20B FUQUA ST. LOOKING SOUTH WEST

PHOTO No. 21B FUQUA ST. @ CHIMNEY ROCK RD LOOKING EAST

PHOTO No. 22B FUQUA ST. LOOKING EAST

APPENDIX G

TRAFFIC STUDY

W. FUQUA STREET TRAFFIC STUDY

Between Missouri City Limits and Bazel Brook Drive

Council District K

City of Houston, Texas

Prepared for:

Submitted to:

Omega Engineers, Inc.

STATE OF TEXAS
MOHAMMAD IRFAN
89333
REGISTERED PROFESSIONAL ENGINEER

2/20/2013

TBPE FIRM REGISTRATION F-9492

Prepared by:

PROGRESSIVE CONSULTING ENGINEERS, PLLC
TRAFFIC · CIVIL · TRANSPORTATION

16360 Park Ten Place, Suite 230, Houston, Texas 77084
Tel: 281-630-5485, Fax: 281-394-5636

WWW.PCEHouston.com

February 21, 2013

EXECUTIVE SUMMARY

Progressive Consulting Engineers, PLLC, (PCE) was authorized by Omega Engineers, Inc. to prepare a traffic assessment for the W. Fuqua Street corridor. The study is a part of the City of Houston pre-engineering work authorization for the corridor.

The purpose of this study is to prepare a traffic assessment with the recommendations for safety and operational improvements and to determine if the study area, W. Fuqua Street between Missouri City limits and Bazel Brook, and all the signalized and STOP control intersections along the study corridor will be adequate to accommodate the expected 2035 projected traffic demand.

The objectives of the study include:

Performing intersection capacity analysis, identifying existing deficiencies and providing recommendations for improvements for the following intersections:

1) W. Fuqua Street at Fondren Road (Signal Control),
2) W. Fuqua Street at Hillcroft Ave (Signal Control),
3) W. Fuqua Street at Blueridge Road (Signal Control),
4) W. Fuqua Street at Ridgerock Road, (All-way **STOP**)
5) W. Fuqua Street at Chimney Rock Road (Signal Control),
6) W. Fuqua Street at W. Ridgecreek Drive (All-way **STOP**).

The study analyses focused on the following three (3) scenarios:

Scenario-1, 2013 Existing Condition
Scenario-2, 2035 Future Condition
Scenario-3, 2035 Future Conditions with Mitigation Measures at the Impacted Intersections

KEY FINDINGS

In conducting the traffic analyses, the following findings and conclusions were made:

The level of service analysis for Scenarios 1, 2 and 3 was performed utilizing traffic analysis software SYNCHRO for all the signalized and STOP control Intersections. All the intersections for Scenarios 1, 2 and 3 found to be operating at level of service "C" or better except the following two intersections under Scenario 3 as these intersections found to be operating at level of service **"F"** to a heavy 2035 projected traffic demand:

Intersection #1, W. Fuqua St at Fondren Rd
Intersection #6, W. Fuqua St at W. Ridgecreek Dr

The Peak Hour Delay Assessment for Intersection #1, W. Fuqua St at Fondren Rd

Morning Peak Hour Delay:
The delay problem during morning peak hour is due to a heavy projected future demand on the eastbound W. Fuqua St approach for the left turning traffic as the existing 2013 left turning traffic increases from 544 vph to 979 vph for the year 2035. This increase resulted for level of service **"F".**

Evening Peak Hour Delay:
The delay problem during evening peak hour is also due to a heavy projected future demand on the southbound Fondren St approach for the right turning traffic as the existing 2013 right turning traffic increases from 468 vph to 842 vph for the year 2035. This increase in traffic resulted for level of service **"F".**

Requirements for an Exclusive Right Turn Lane and Double Left Turn Lane:

EXCLUSIVE RIGHT TURN LANE
In general, a right turn lane is warranted at a signalized intersection when the right turning traffic volume exceeds 300 vph. In analyzing the traffic data, it is found out that the following approaches at the subject intersections satisfy the criteria:

DOUBLE LEFT TURN LANE
The guidelines for considering the double left-turn lanes are provided in Chapter 11 of Traffic Engineering Hand Book by ITE. It says, typically, design volume of 400 vph or more represents a threshold at which double-left turn lanes should be considered.

Based on the above guidelines, both the eastbound W. Fuqua Street approach and the southbound Fondren Road approach satisfied a 2nd left turn lane and an exclusive right turn lane for the referenced approaches respectively.

The Peak Hour Delay Assessment for Intersection #6, W. Fuqua St at W. Ridgecreek Dr

Evening Peak Hour Delay:
The delay problem at this three-way STOP control intersection is basically during evening peak hour and it is due to a heavy projected future demand on both eastbound and westbound W. Fuqua St approaches. The existing 2013 evening peak hour traffic on eastbound and westbound approaches increases for the 2035 projected evening peak hour condition from 468 vph to 842 vph and 516 vph to 929 vph respectively. This increase in traffic resulted for level of service **"F".**

Recommendations for a Traffic Signal Installation at W. Fuqua St at W. Ridgecreek Dr

Our cursory review of the projected 2035 future traffic volumes satisfied the peak hour warrant criteria for installing a traffic signal at this intersection. Therefore, the intersection capacity

analysis for this intersection was revised with a traffic signal control. The signal installation at this intersection will improve level of service from "F" to "B" as listed in Table 5 of the report.

Note: A detail traffic signal warrant study with a crash analysis for this intersection is recommended before a decision to install a traffic signal is finalized in the future.

Requirement for an Exclusive Left Turn Lane on EB W. Fuqua St at Hillcroft Ave:

The level of service evaluation for the intersection of W. Fuqua St and Hillcroft Ave was also revised with a proposed dedicated left turn lane on eastbound W. Fuqua St as currently this intersection is missing the left turn lane on the eastbound approach. Even though, there is no deficiency with the current operations, an exclusive left turn lane is recommended to improve safety and through traffic as the through traffic appears to be impacted due to occasional turning traffic.

Table 5 of the report summarizes the 2035 levels of service with improvements as described above for the three signalized intersections

The results show that the levels of service with recommended improvements improve as follows:

Intersection #1, W. Fuqua St at Fondren Rd
The intersection of W. Fuqua St and Fondren Rd improved to an acceptable level of service **"D"** from a failing condition for both the morning and evening peak hours.

Intersection #6, W. Fuqua St at W. Ridgecreek Dr
The intersection of W. Fuqua St and W. Ridgecreek Dr improved to level of service **"B"** from a failing condition for both the morning and evening peak hours.

Intersection #2, W. Fuqua St at Hillcroft Ave
This intersection maintained level of service **"B"** with the addition of exclusive left turn lane on the eastbound W. Fuqua St as the turn lane is needed to improve the through progression.

NOTE:

The remaining intersections were not needed to be revised as each of the remaining intersections found to be at level of service "C" or better. The results of intersection capacity analyses are listed in **Tables 3, 4 and 5** of the report. . The detail LOS computations (SYNCHRO outputs) for each intersection are contained in the **Appendix B**.

SUMMARY OF FINAL RECOMMENDATIONS

Based on the results of the analysis and findings of this study, the following recommendations are made for the study corridor and each of the study intersections based on the current safety and operational issues and also to address the projected future traffic demand:

W. Fuqua Street Corridor

Based on the above City criteria as discussed in Section IV of the report, it is assumed that the study corridor will be operating at acceptable level of service "D" for pretty much throughout the study corridor for the 2035 projected year.

Intersection #1, W. Fuqua Street at Fondren Road (Signalized Intersection):

The following improvements are recommended for Intersection #1:

- Add 2nd left turn lane on eastbound W. Fuqua St with a proposed storage of 300 ft.
- Add a dedicated right turn lane on southbound Fondren Rd with a proposed storage of 300 ft. and revise the middle lane to provide a shared left and thru movement.
- Install a new mast arm signal system as existing does not meet the City standards
- Install ADA wheelchair ramps and crosswalk pavement markings
- Install Pedestrian Count Down signal system
- Install Audible Pedestrian Signals (APS) settings.
- Optimize signal phasing & timings.

Intersection #2, W. Fuqua Street at Hillcroft Ave:

Based on the current safety and operational deficiencies, the following improvements are recommended for Intersection #2:

- Add an exclusive left turn lane on eastbound W. Fuqua St with minimum 100-150 ft. storage.
- Install a separate left turn lane signal indication (a three sections signal head on existing mast arm facing the eastbound traffic)
- Install ADA wheelchair ramps and crosswalk pavement markings
- Install Pedestrian Count Down signal system
- Install Audible Pedestrian Signals (APS) settings.
- Optimize signal phasing & timings.

Intersection #3, W. Fuqua Street at Hillcroft Ave:

Based on the current safety and operational deficiencies, the following improvements are recommended for Intersection #3:

- Install mast arm mounted street sign for eastbound traffic.
- Install ADA wheelchair ramps and crosswalk pavement markings.
- Install Pedestrian Count Down signal system.
- Install Audible Pedestrian Signals (APS) settings.
- Optimize signal phasing & timings.

Intersection #4, W. Fuqua Street at Ridgerock Road (ALL-WAY STOP):

Based on the current safety and operational deficiencies, the following improvements are recommended for Intersection #4:

- Install ADA wheelchair ramps and crosswalk pavement markings.
- Install a dedicated left turn lane on both EB and WB approaches with minimum 75-100 ft storage.

NOTE: The City may need to consider converting to a minor approach STOP control intersection in the future to improve mobility along the major corridor.

Intersection #5, W. Fuqua Street at Chimney Rock Road:

Based on the current safety and operational deficiencies, the following improvements are recommended for Intersection #5:

- Install Pedestrian Count Down signal system.
- Install Audible Pedestrian Signals (APS) settings.
- Optimize signal phasing & timings.

Intersection #6, W. Fuqua Street at W. Ridgecreek Drive:

Based on the current safety and operational deficiencies, the following improvements are recommended for Intersection #6:

- Consider installing a traffic signal at this intersection with a Pedestrian Count Down signal system.
- Install Audible Pedestrian Signals (APS) settings with the new signal system.
- Optimize signal phasing & timings.

General Statement for Interconnecting Traffic Signaslalong W. Fuqua Corridor:

It is recommended to interconnect all the existing and future traffic signal along the corridor to improve mobility and safety.

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I. INTRODUCTION

Progressive Consulting Engineers, PLLC is pleased to submitt a traffic assessment of the W.Fuqua Street corridor for the City Houston. The following subsections document the purpose and objectives of the study, study area location, and study methodology.

A. PURPOSE AND OBJECTIVES

The purpose of this study is to determine if the study area, W. Fuqua Street between Missouri City limits and Bazel Brook, and all the signalized and STOP control intersections along the study corridor will be adequate to accommodate the expected 2035 projected traffic demand.

The objectives of the study include:

Performing intersection capacity analysis, identifying existing deficiencies and providing recommendations for improvements for the following intersections:

1) W. Fuqua Street at Fondren Road (Signal Control),
2) W. Fuqua Street at Hillcroft Ave (Signal Control),
3) W. Fuqua Street at Blueridge Road (Signal Control),
4) W. Fuqua Street at Ridgerock Road, (All-way **STOP**)
5) W. Fuqua Street at Chimney Rock Road (Signal Control),
6) W. Fuqua Street at W. Ridgecreek Drive (All-way **STOP**).

The study analyses focused on the following three (3) scenarios:
Scenario-1, 2013 Existing Condition
Scenario-2, 2035 Future Condition
Scenario-3, 2035 Future Conditions with Mitigation Measures at the Impacted Intersections

Traffic analysis software SYNCHRO was used to evaluate the current and future levels of services for the above listed intersections.

B. STUDY AREA LOCATION

The study area along W. Fuqua Street is located approximately 1.83 miles from Missouri City Limit to Bazel Brook St, 9,671 ft, in the City of Houston, Fort Bend County, Texas. The study area is located in Council District K with limits from Missouri City limits to Bazel Brook St. The relevent Key Map numbers are 570Z and 571W. GIMS block map numbers are 5050b and 5150a.

Figure 1 - Location Map on the next page shows the study area limits.

Figure -1. Project Location Map

C. STUDY METHODOLOGY

The development of the study tasks include the following activities:

- Field visit the proposed corridor to observe: roadway network, traffic flow patterns, traffic controls devcies, roadway geometry, land use characteristics, driveway locations, and other site characteristics necessary to conduct the intersection capacity analysis;
- Obtain operational data for existing traffic signals;
- Obtain existing and future projected traffic data from the City of Houston;
- Conduct peak hour turning movement counts at the selected critical intersections (AM and PM peak hours);
- Prepare traffic count summaries reflecting the traffic patterns during the morning and evening peak hours.
- Perform Intersection Capacity analysis for existing 2013 AM and PM peak hour conditions (Scenario-1);
- Develop 2035 AM and PM background traffic volumes with growth factor provided by the City;
- Perform Intersection Capacity analysis for 2013 Exist+2035 background AM and PM peak hour conditions (Scenario-2);
- Perform Intersection Capacity analysis for 2013 Exist+2035 background+With Mitigation Measures for AM and PM peak hour conditions (Scenario-3);
- Identify mitigation measures based on the results of the analysis;
- Identify deficiencies at each of the selected intersections;
- Document all analyses, findings, conclusions, and recommendations; and
- Write up of traffic analysis report.

The traffic impact evaluation was comprised of three (3) scenarios for which both AM and PM peak hour Level of Service (LOS) analyses were performed for the study intersections and accomplished via the *Synchro 6* software.

Table 1 provides a summary of the assumptions used in each of the three (3) scenarios, shown on the next page.

Table 1- Analysis Scenario Summary

Scenario	Roadway Conditions	Traffic Volumes
Scenario-1 2013 Existing Condition	Existing Roadway w/Existing Signal Phasing & Timing (for Signalized Intersections)	Existing
Scenario-2 2035 Future Condition	Existing Roadway w/Existing Signal Phasing & Timing (for Signalized Intersections)	Existing+Future Projected Traffic with Average Annual Growth Rate of 2.72% *
Scenario-3 2035 Future Conditions with Mitigation Measures at the Impacted Intersections	Existing Roadway+ Proposed Turn Lane (s) Improvements+Optimized Signal Phasing & Timing	Existing+Future Projected Traffic with Average Annual Growth Rate of 2.72% *

NOTE:
Per the data provided by the City of Houston, the annual growth rate of traffic between 2011 and 2035 for different segments of W. Fuqua Street is estimated to be as follows:

Segment-1:
The annual growth rate on Fuqua Street between Chimney Rock and Blueridge = 2.77%

Segment-2:
The annual growth rate on Fuqua Street between Blueridge Rd to FB Toll Rd = 2.51%

Segment-3:
The annual growth rate on Fuqua Street between FB Toll Road to Fondren Rd = 2.89%

* Assumption: The average of the above three, **2.72%**, was used for 2035 traffic.

II. AREA CONDITIONS

The purpose of this section is to document a summary of findings of existing traffic flow and land use, existing traffic control devices, and existing and projected average daily traffic (ADTs) for the subject project corridor as outlined below.

A. EXISTING TRAFFIC FLOW AND LAND USE

W. Fuqua Street is an east-west four lane divided boulevard roadway. It connects to south Sam Houston Parkway west on the easternmost side and indirectly to Fort Bend Toll Road through Hillcroft Avenue near the easternmost end. Currently, the posted speed limit on Fuqua Street within the project limit varies from 30 mph to 35 mph in both directions. W. Fuqua Street eastbound section between Blueridge Road and a point approximately 150 ft. east of Bazel Brook Drive is posted with 30 miles per hour. W. Fuqua Street westbound section between points approximately 50 ft. west of Bazel Brook Drive to approximately 300 ft. west of Blueridge Road is posted with 30 miles per hour. The rest of the corridor within the project limit is posted with 35 miles per hour and no restriction to street parking.

There are four signalized intersections along W. Fuqua Street at Fondren Street, Blueridge Road, Hillcroft Avenue and Chimney Rock Road. However, our field observations reveal that the traffic flow along W. Fuqua Street is constrained by the All Way STOP Control intersections, W. Fuqua Street at Ridgerock Drive and W. Fuqua Street at W. Ridgecreek Drive, the T-intersection about 400 ft. east of Chimney Rock Road.

The land use along both sides of Fuqua Street is predominantly with residential houses and "No Parking" restriction. Some commercial and retail businesses are located along Fuqua Street at Blueridge Road and Chimney Rock Road. A few pedestrian observed during morning and evening peak hours at these intersections.

Briargate Elementary School is located at 15817 Blueridge Road, approximately 800 ft. south of Fuqua Street in the northeast corner of Blueridge Road and Laughlin Drive. The school crossing signs with down arrows (S1-1 & W16-7p) are installed at the intersection of W. Fuqua Street and Blueridge Road in all four corners and in the median areas. A short school speed zone is established along Blueridge Road within 500 ft. south of W. Fuqua Street.

There are two adjacent churches, Fondren Seventh Day Adventist Church and Living World Faith Center Church, located in the northeast corner of W. Fuqua Street and Fondren Road. The first two median cuts along W. Fuqua Street east of Fondren St provide access to their main drives without a dedicated left turn lane on eastbound W. Fuqua Street approach at each

of the driveway location. This is a potential rear end situation with increased projected through traffic. A private school, Southern Preparatory Academy, located next to Living World Faith Church on the eastside has a similar situation with no left turn lane on eastbound W. Fuqua Street at the main driveway access.

B. TRAFFIC VOLUMES

The turning movement counts data at the critical intersections was collected on January 29, 2013 from 4:30 to 6:30 in the evening peak period and 6:30 to 8:30 in the morning. The additional turning movement counts data at the intersection of W. Fuqua St and W. Ridgecreek Dr was collected on February 14, 2013 from 4:30 to 6:30 in the evening peak period and 6:30 to 8:30 in the morning.

This data formed the basis for the operational analysis. The turning movement counts are included in **APPENDIX**.

C. EXISTING AND PROJECTED AVERAGE DAILY TRAFFIC

The traffic volumes were collected at the study intersections as identified critical intersections for the corridor. The weekday Average Daily Traffic (ADT's) counts data on W Fuqua Street was provided by the City of Houston.

Per the data provided by the City of Houston, the annual growth rate of traffic between 2011 and 2035 for different segments of W. Fuqua Street is estimated to be as follows:

Segment-1:
The annual growth rate on Fuqua Street between Chimney Rock and Blueridge = 2.77%
Segment-2:
The annual growth rate on Fuqua Street between Blueridge Road to FB Toll Road = 2.51%
Segment-3:
The annual growth rate on Fuqua Street between FB Toll Road to Fondren Road = 2.89%

Assumption: The average of above three was used for 2035 traffic projection = **2.72%**

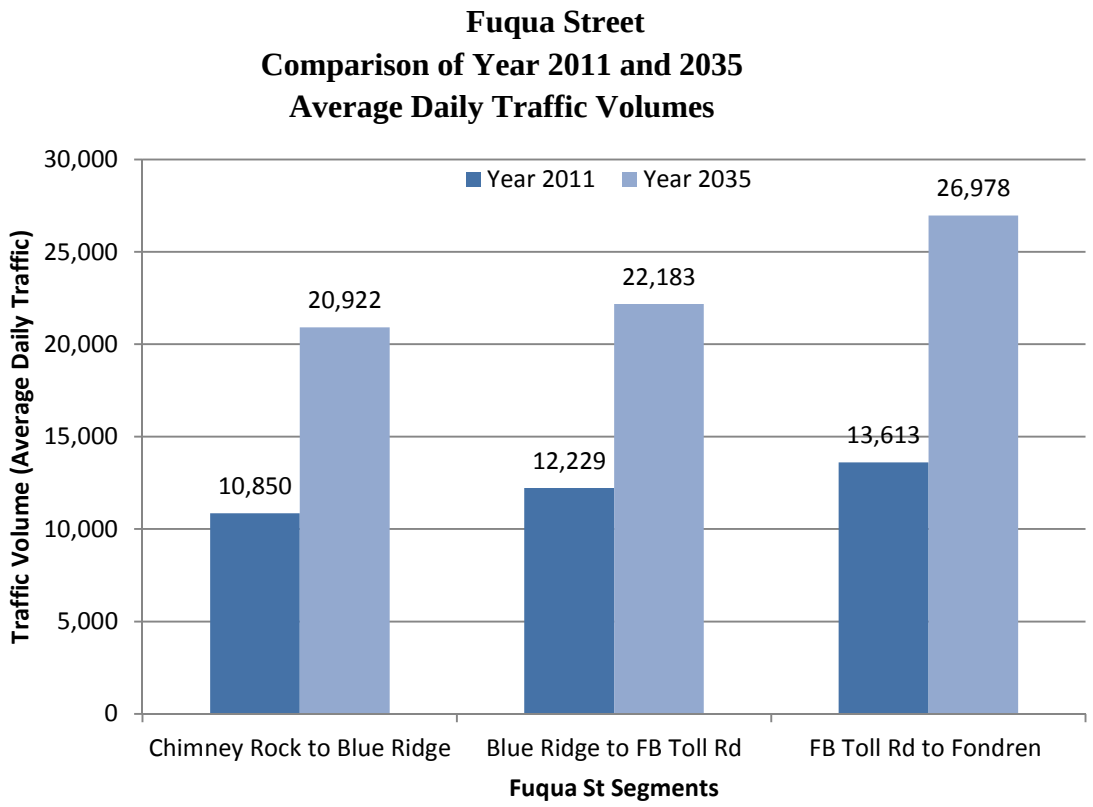

Figure-2 – Average Daily Traffic Volume Comparison Chart

III. DEFICIENCIES AT SIGNAL & STOP CONTROLS

This section documents the deficiencies observed during the field visits as poor safety conditions and traffic operations related issues exist at the following study area signalized and unsignalized all-way STOP control intersections:

1) W. FUQUA STREET AT FONDREN ROAD

A brief description of deficiencies at this intersection is listed below:

- Signal head is not provided for the northbound and southbound Fondren Street left turn movement within a 20 degree cone of vision.
- Push buttons are not provided in the southwest corner of the intersection.
- Crosswalk does not continue for the entire intersection.
- Obliterated arrow and word pavement markings are visible.
- Safety light pole cables are tied to existing signal pole and mast arm.
- No signal backplates and count down pedestrian signals.
- Extended concrete divider between left turn lane and thru lane poses safety hazard to pedestrian.

2) W. FUQUA STREET AT HILLCROFT AVENUE

A brief description of deficiencies at this intersection is listed below:

- A dedicated left turn lane on eastbound W. Fuqua Street is missing. In general, a dedicated left turn lane improves the overall safety and intersection operation.
- Obliterated crosswalk pavement markings are so visible.
- No countdown pedestrian signal heads are installed.
- Overall signal hardware system is in good condition.

3) W. FUQUA STREET AT BLUERIDGE ROAD

A brief description of deficiencies at this intersection is listed below:

- Obliterated crosswalk pavement markings are so visible. Overall intersection pavement markings are in real bad conditions.
- Southbound Blueridge Road approach provides narrow lanes and no dedicated left turn lane.
- Mast arm mounted street sign for eastbound traffic is missing.

- Street name sign pole is falling in southeast corner.
- No countdown pedestrian signal heads are installed.
- Overall signal hardware system is in good condition.

4) W. FUQUA STREET AT RIDGEROCK ROAD (ALL-WAY STOP)

A brief description of deficiencies at this intersection is listed below:

- Currently, no overall intersection pedestrian crosswalk is provided.
- A dedicated left turn lane is not provided on eastbound and westbound W. Fuqua Street approaches.
- The stop signs impede the through traffic on W. Fuqua St in both directions during peak hours.

5) W. FUQUA STREET AT CHIMNEY ROCK ROAD

A brief description of deficiencies at this intersection is listed below:

- Obliterated arrow and word pavement markings are visible.
- No countdown pedestrian signals are installed.
- Broken concrete divider between left turn lane and thru lane poses safety hazard to pedestrian.
- Entire intersection requires pavement markings.
- Overall signal hardware is in good conditions.

6) W. FUQUA STREET AT W. RIDGECREEK DRIVE (ALL-WAY STOP)

A brief description of deficiencies at this intersection is listed below:

- No overall intersection pedestrian crosswalk is provided.
- The stop signs impede the through traffic on W. Fuqua St in both directions during peak hours.

General Statement for Traffic Signal Control Devices:
Currently, the above signalized intersections do not provide coordination throughout the corridor. Furthermore, all the signalized intersections do not have Audible Pedestrian Signals (APS) settings installed.

IV. ROADWAY & INTERSECTION CAPACITY ANALYSIS

A. ROADWAY LEVEL OF SERVICE CRITERIA

Per the City MTFP Policy Statement, roadways are analyzed in terms of peak-hour volumes because that is when the roadways are at maximum operation. The peak hour generally constitutes 8 to 12 percent of the total daily traffic, and it is common to use 10 percent of the average daily traffic volume to represent the peak hour flow.

The effectiveness of the roadway in maintaining an acceptable standard of traffic flow, given its design capacity, is evaluated in terms of its level-of-service (LOS). Level-of-service ratings use an alphabetic scale with "A" as most free-flowing and "F" as having severe congestion. The LOS is calculated by taking the peak hour flow (10% of the daily total traffic) and divided by the number of lanes of the roadway, and then applying the result to the following scale to assign the roadway level-of-service:

Level of Service (LOS)	Vehicle Trips (Peak hour)
A	**0-199**
B	**200-349**
C	**350-499**
D	**500-649**
E	**650-799**
F	**800 or more**

Below is a further explanation of the characteristics of each level-of-service:

LOS A: Primarily free flow operations at average travel speeds-90 percent or more of the free flow speed. Vehicles are completely unimpeded in their ability to maneuver within the traffic. Stopped delay at intersection is minimal.

LOS B: Reasonably unimpeded operation at average travel speeds-usually about 70 percent of the free flow speed. The ability to maneuver in the traffic stream is only slightly restricted and stopped delays are not bothersome.

LOS C: Stable operations. However, ability to maneuver and change lanes mid-block may be restricted than LOS "B", and longer queues and/or adverse signal coordination may contribute to lower average travel speeds-about 50 percent of the free-flow speed.

LOS D: Small increases in flow may cause substantial increase in approach delay and decreases in arterial speed. Average travel speeds are about 40 percent of free-flow speed.

LOS E: Significant approach delays and average travel speeds of one-third of the free-flow speed or lower.

LOS F: Extremely low speed below one-third of the free-flow speed. Intersection congestion is likely at critical intersections, with high approach delays resulting.

The City provided the following projected 2035 daily traffic volumes for the study corridor as described below:

Segment 1,
Chimney Rock to Blueridge Rd = 20,922 ADT

Segment 2,
Blueridge Rd to FB Toll Rd = 22,183 ADT

Segment 3,
FB Toll Rd to Fondren Rd = 26,978 ADT

Considering the City MTFP Policy Statement criteria to assess roadway level of service, we get the following results:

- ***Segment-1***

  ADT for Segment 1 = 20,922 (2035 average daily traffic),
  Assuming 10% peak hour flow of projected ADT,
  10% of 20,922/4 lanes = 523, which gives LOS "D" as per LOS criteria outlines above

- ***Segment-2***

  ADT for Segment 2 = 22,183, (2035 average daily traffic),
  Assuming 10% peak hour flow of projected ADT,
  10% of 22,183/4 lanes = 555, which gives LOS "D" as per LOS criteria outlines above

- ***Segment-3***

  ADT for Segment 3 = 26,978 (2035 average daily traffic),
  Assuming 10% peak hour flow of projected ADT,
  10% of 26, 978/4 lanes = 674, LOS "E", which 25 trips over the LOS "D" (500-649 trips)

Since the number of trips for segment 3 exceed only 25 trips from the maximum LOS "D" requirement, segment 3 is determined to be LOS "E" for year 2035. However, this slight increase from acceptable LOS "D" would not have a significant impact on roadway free flow speed and thus the impact on additional delay could be assumed negligible.

Based on the above City criteria, it is assumed that the study corridor will be operating at acceptable level of service "D" for pretty much throughout the study corridor for the 2035 projected year.

B. INTERSECTION CAPACITY ANALYSIS

This section includes a discussion of the operational analysis for the study area signalized and unsignalized intersections. The analysis was conducted for all three (3) scenarios described in Section-I of this report.

A traffic simulation model of the study intersection was developed using Synchro Version 6 traffic simulation software to assist in the analysis of existing conditions during the morning and evening peak hour. Based on the results of the simulation, a level of service analysis was completed.

Level of Service (LOS) is a letter designation that describes the range of operating conditions on a particular type of facility. The *Highway Capacity Manual 2000* describes level of service as a "quality measure describing operational conditions within a traffic stream, generally in terms of such service measures as speed and travel time, freedom to maneuver, traffic interruptions, and comfort and convenience." Six levels of service are defined for capacity analysis. Letters designate each level, from LOS A to LOS F, with LOS A representing the best operating conditions and LOS F the worst.

According to City of Houston Infrastructure Design Manual, the minimum acceptable level of service is D. In the event where the intersection LOS exceeds that threshold with the addition of projected traffic, it is highly recommended to propose mitigation, within reason, to reduce the LOS to the acceptable level. Examples of mitigation measures include changing the traffic signal timing, re-striping of traffic lanes, or constructing additional traffic lanes.

Table 2 on the next page shows the level of service criteria for signalized and unsignalized intersections. The level of service criteria are defined as a measure of "control delay," which is the average delay, measured in seconds per vehicle, experienced by motorists at an intersection.

Table 2 - Definition of Level of Service for Signalized and Unsignalized Intersections			
Level of Service	**Average Control Delay Per Vehicle (sec/veh)**		**Description**
	Signalized	**Unsignalized**	
A and B	≤ 10 (A) > 10 and ≤ 20 (B)	≤ 10 (A) > 10 and ≤ 15 (B)	No delay at intersection with continuous flow traffic. Uncongested operations; high frequency of long gaps available for all left and right-turning traffic; no observable queues.
C	> 20 and ≤ 35	> 15 and ≤ 25	Moderate delay at intersection with satisfactory to good traffic flow. Light congestion; infrequent backups on critical approaches.
D	> 35 and ≤ 55	> 25 and ≤ 35	Increased probability of delays along every approach. Significant congestion on critical approaches, but intersection functional. No standing lines formed.
E	> 55 and ≤ 80	> 35 and ≤ 50	Heavy traffic flow condition. Heavy delays probable. No available gaps for cross street traffic or main street turning traffic. Limit of stable flow.
F	> 80	> 50	Unstable traffic flow. Heavy congestion. Traffic moves in forced flow condition. Average delays greater than one minute highly probable. Total breakdown.

NOTE:

The level of service criteria are defined as a measure of "control delay," which is the average delay, measured in seconds per vehicle, experienced by motorists at an intersection.

C. 2013 EXISTING LEVEL OF SERVICE (LOS) EVALUATION (SCENARIO-1)

Table 3 on the next page summarizes the existing levels of service at the study intersections during the weekday morning and evening peak hour. The table also shows each of the approaches LOS for signalized and unsignalized intersections. This information illustrates those specific movements that are experiencing high levels of delay. The detail LOS computations (SYNCHRO outputs) for each intersection are contained in the **Appendix B**.

Table 3 - Level of Service (LOS) Analysis Summary_ Existing 2013 Condition

Intersection #1 Signalized Intersection at W. Fuqua St at Fondren Rd				
APPROACH	**AM Peak Hour**		**PM Peak Hour**	
	LOS	**Delay (Sec/Veh)**	**LOS**	**Delay (Sec/Veh)**
NB Fondren Rd Approach	B	13.1	B	14.1
SB Fondren Rd Approach	A	8.3	A	7.4
EB W. Fuqua St Approach	C	32.4	B	13.2
WB W. Fuqua St Approach	B	11.1	C	20.6
Intersection LOS	**C**	**20.3**	**B**	**12.5**

Intersection #2 Signalized Intersection at W. Fuqua St at Hillcroft Ave				
APPROACH	**AM Peak Hour**		**PM Peak Hour**	
	LOS	**Delay (Sec/Veh)**	**LOS**	**Delay (Sec/Veh)**
NB Hillcroft Ave Approach	A	4.3	A	4.8
SB Hillcroft Ave Approach	A	4	A	6.8
EB W. Fuqua St Approach	B	15.7	C	20.8
WBW. Fuqua St Approach	B	14.3	B	17
Intersection LOS	**B**	**13.4**	**B**	**16.4**

Intersection #3 Signalized Intersection at W. Fuqua St at Blueridge Rd				
APPROACH	**AM Peak Hour**		**PM Peak Hour**	
	LOS	**Delay (Sec/Veh)**	**LOS**	**Delay (Sec/Veh)**
NB Blueridge Rd Approach	A	7.8	A	7.8
SB Blueridge Rd Approach	A	8.2	A	7.1
EB W. Fuqua St Approach	B	10	B	11.9
WB W. Fuqua St Approach	B	13.3	B	13.9
Intersection LOS	**B**	**10**	**B**	**11.2**

Intersection #4 Unsignalized Intersection at W. Fuqua St at Ridgerock Rd				
APPROACH	**AM Peak Hour**		**PM Peak Hour**	
	LOS	**Delay (Sec)**	**LOS**	**Delay (Sec)**
NB Ridgerock Rd Approach	A	9	A	8.7
SB Ridgerock Rd Approach	A	8.9	A	8.9
EB W. Fuqua St Approach	A	8.6	A	8.7
WB W. Fuqua St Approach	A	8.7	A	9.1
Intersection LOS (Average Delay)	**A**	**8.7**	**A**	**8.9**

Table 3 - Level of Service (LOS) Analysis Summary_ Existing 2013 Condition
(Continued from previous page)

Intersection #5 Signalized Intersection at W. Fuqua St at Chimney Rock Rd				
APPROACH	**AM Peak Hour**		**PM Peak Hour**	
	LOS	**Delay (Sec/Veh)**	**LOS**	**Delay (Sec/Veh)**
NB Chimney Rock Rd Approach	B	12.8	B	15.6
SB Chimney Rock Rd Approach	B	15.1	B	17.2
EB W. Fuqua St Approach	B	18.4	B	17.2
WB W. Fuqua St Approach	B	16.9	B	18.1
Intersection LOS	**B**	**15.7**	**B**	**17.2**
Intersection #6 Unsignalized Intersection at W. Fuqua St at W. Ridgecreek Dr				
APPROACH	**AM Peak Hour**		**PM Peak Hour**	
	LOS	**Delay (Sec)**	**LOS**	**Delay (Sec)**
NB Ridgecreek Dr Approach	B	11	B	10.9
EB W. Fuqua St Approach	A	10.5	B	12.1
WB W. Fuqua St Approach	B	9.8	B	14.5
Intersection LOS (Average Delay)	**B**	**10.5**	**B**	**12.9**

Note: The results are based on the existing phasing and timings.

As shown in **Table 3**, the above study intersections along W. Fuqua corridor are currently operating at level of service "C" or better for the morning and evening peak hours as highlighted in yellow.

Figures 3 & 4 shown in the following pages, depict the existing AM and PM peak hour traffic volumes, intersections levels of service and lane configuration respectively.

The detail LOS computations (SYNCHRO outputs) for each intersection are contained in the **Appendix B.**

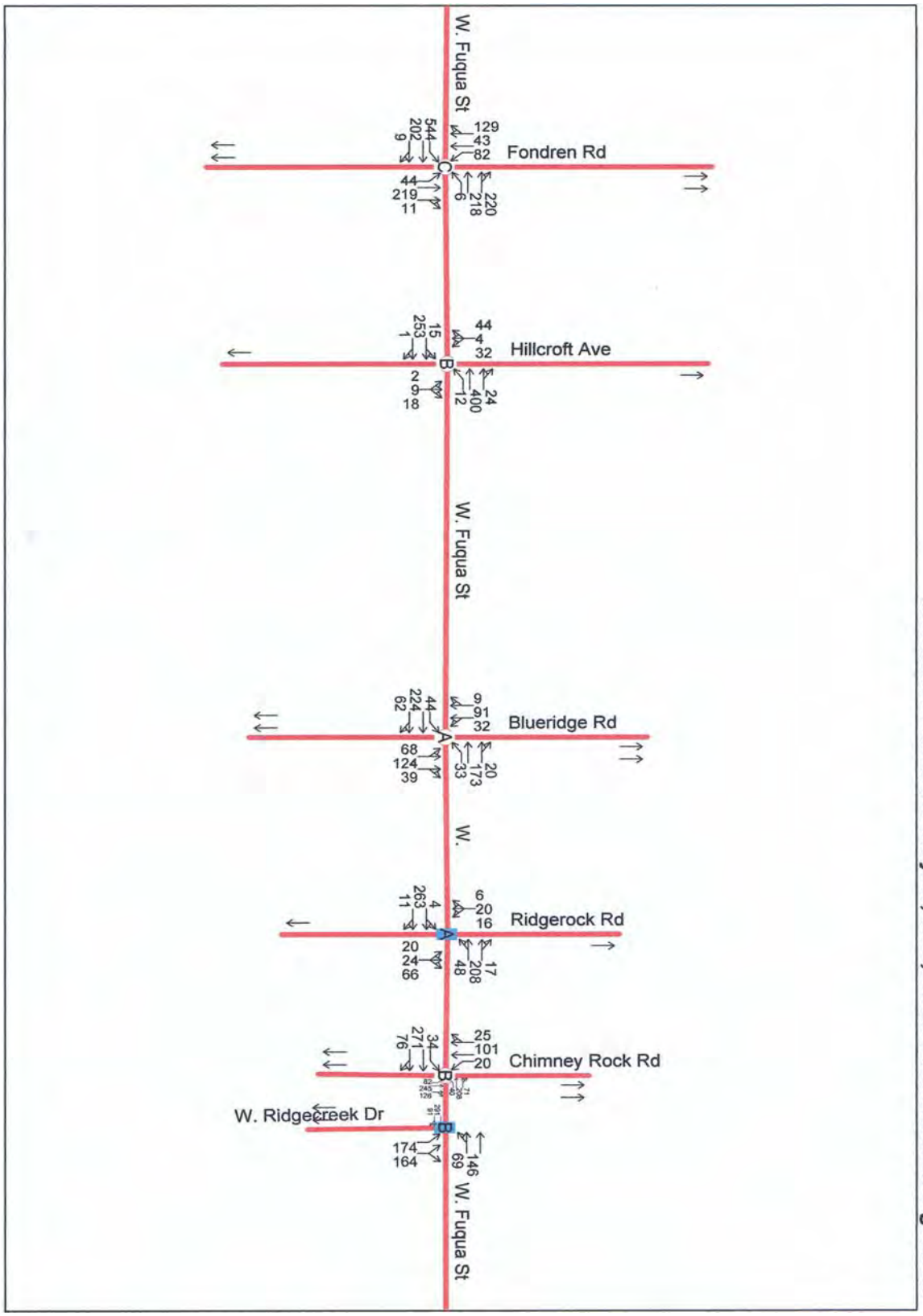

FIGURE-3
Scenario 1-AM 2013 Analysis, LOS, Volumes & Lane Configuration

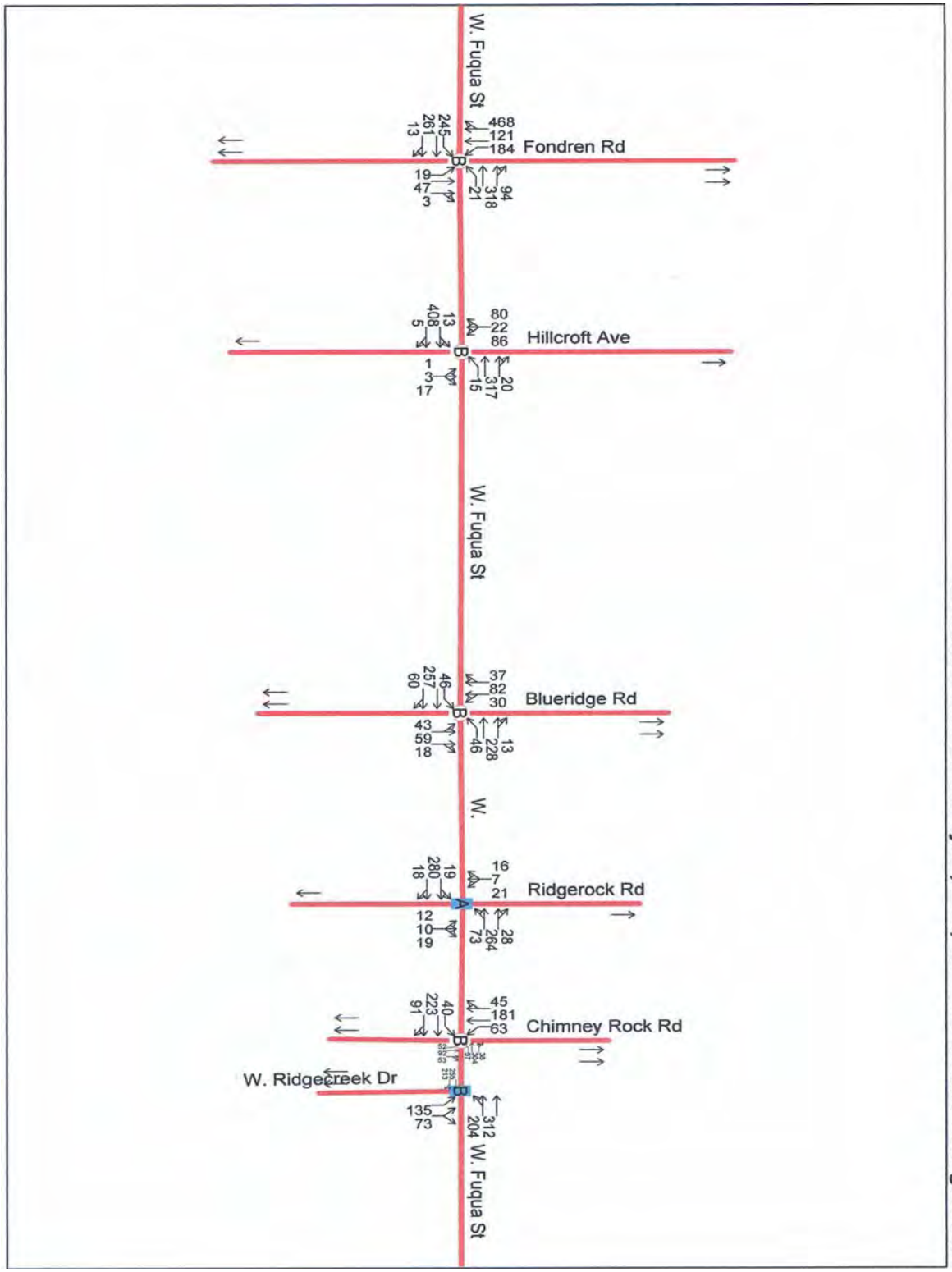

FIGURE-4
Scenario 1-PM 2013 Analysis, LOS, Volumes & Lane Configuration

D. 2035 LEVEL OF SERVICE (LOS) EVALUATION (SCENARIO-2)

An annual growth rate of 2.72 applied to existing 2013 traffic volumes to account for 2035 background traffic condition. The growth rate was calculated based on the City's provided existing and projected 2035 average daily traffic. The calculation criterion is outlined in Section II, Part C of the report.

Table 4 on the next page summarizes the 2035 levels of service for the study intersections during the weekday morning and evening peak hours. The table also shows each of the approaches LOS for signalized and unsignalized intersections. This information illustrates those specific movements that are experiencing high levels of delay. The detail LOS computations (SYNCHRO outputs) for each intersection are contained in the **Appendix B**.

Table 4 - Level of Service (LOS) Analysis Summary_ 2035 Condition

Intersection #1 Signalized Intersection at W. Fuqua St at Fondren Rd				
APPROACH	**AM Peak Hour**		**PM Peak Hour**	
	LOS	**Delay (Sec/Veh)**	**LOS**	**Delay (Sec/Veh)**
NB Fondren Rd Approach	C	22.6	**F**	83.2
SB Fondren Rd Approach	C	22.8	**F**	343.5
EB W. Fuqua St Approach	**F**	364.3	D	36.2
WB W. Fuqua St Approach	C	20.8	C	23.9
Intersection LOS	**F**	**171.6**	**F**	**147.8**

Intersection #2 Signalized Intersection at W. Fuqua St at Hillcroft Ave				
APPROACH	**AM Peak Hour**		**PM Peak Hour**	
	LOS	**Delay (Sec/Veh)**	**LOS**	**Delay (Sec/Veh)**
NB Hillcroft Ave Approach	A	6.8	A	7.6
SB Hillcroft Ave Approach	A	9.2	B	17.4
EB W. Fuqua St Approach	B	17.5	C	23
WBW. Fuqua St Approach	B	14.1	B	16.2
Intersection LOS	**B**	**14.5**	**B**	**19.2**

Intersection #3 Signalized Intersection at W. Fuqua St at Blueridge Rd				
APPROACH	**AM Peak Hour**		**PM Peak Hour**	
	LOS	**Delay (Sec/Veh)**	**LOS**	**Delay (Sec/Veh)**
NB Blueridge Rd Approach	B	13.4	B	12.3
SB Blueridge Rd Approach	B	12.7	B	11.1
EB W. Fuqua St Approach	B	13.5	B	14.4
WB W. Fuqua St Approach	B	14.9	B	15.6
Intersection LOS	**B**	**13.7**	**B**	**13.9**

Intersection #4 Unsignalized Intersection at W. Fuqua St at Ridgerock Rd				
APPROACH	**AM Peak Hour**		**PM Peak Hour**	
	LOS	**Delay (Sec)**	**LOS**	**Delay (Sec)**
NB Ridgerock Rd Approach	B	12.9	B	10.8
SB Ridgerock Rd Approach	B	11.3	B	11
EB W. Fuqua St Approach	B	13.8	B	14.2
WB W. Fuqua St Approach	B	14.2	C	17
Intersection LOS (Average Delay)	**B**	**13.7**	**C**	**15.2**

Table 4 - Level of Service (LOS) Analysis Summary_ 2035 Condition *(Continued)*

Intersection #5 Signalized Intersection at W. Fuqua St at Chimney Rock Rd				
APPROACH	**AM Peak Hour**		**PM Peak Hour**	
	LOS	**Delay (Sec/Veh)**	**LOS**	**Delay (Sec/Veh)**
NB Chimney Rock Rd Approach	C	31.3	C	24.3
SB Chimney Rock Rd Approach	C	22.1	C	29
EB W. Fuqua St Approach	C	21.1	C	23.6
WB W. Fuqua St Approach	B	19.5	C	22.7
Intersection LOS	**C**	**24.4**	**C**	**24.5**
Intersection #6 Unsignalized Intersection at W. Fuqua St at W. Ridgecreek Dr				
APPROACH	**AM Peak Hour**		**PM Peak Hour**	
	LOS	**Delay (Sec)**	**LOS**	**Delay (Sec)**
NB Ridgecreek Dr Approach	D	33.9	C	18.2
EB W. Fuqua St Approach	D	30.6	**F**	77
WB W. Fuqua St Approach	C	18.7	**F**	117.3
Intersection LOS (Average Delay)	**C**	**28.9**	**F**	**84.2**

Note: The results are based on the existing phasing and timings.

As shown in **Table 4**, the signalized intersection of W. Fuqua St and Fondren Rd will be operating at failing condition, Level of service "F" for both morning and evening peak hours.

The unsignalized intersection (A three-way STOP Control) of W. Fuqua St and Ridgecreek Dr will also be operating at failing condition, level of service "F" for the evening peak hour.

The rest of the intersections along the study corridor will be operating at level of service "C" or better for the morning and evening peak hours as highlighted above.

Figures 5 & 6 shown in the following pages, depict the existing AM and PM peak hour traffic volumes, intersections levels of service and lane configuration respectively.

The detail LOS computations (SYNCHRO outputs) for each intersection are contained in the **Appendix B.**

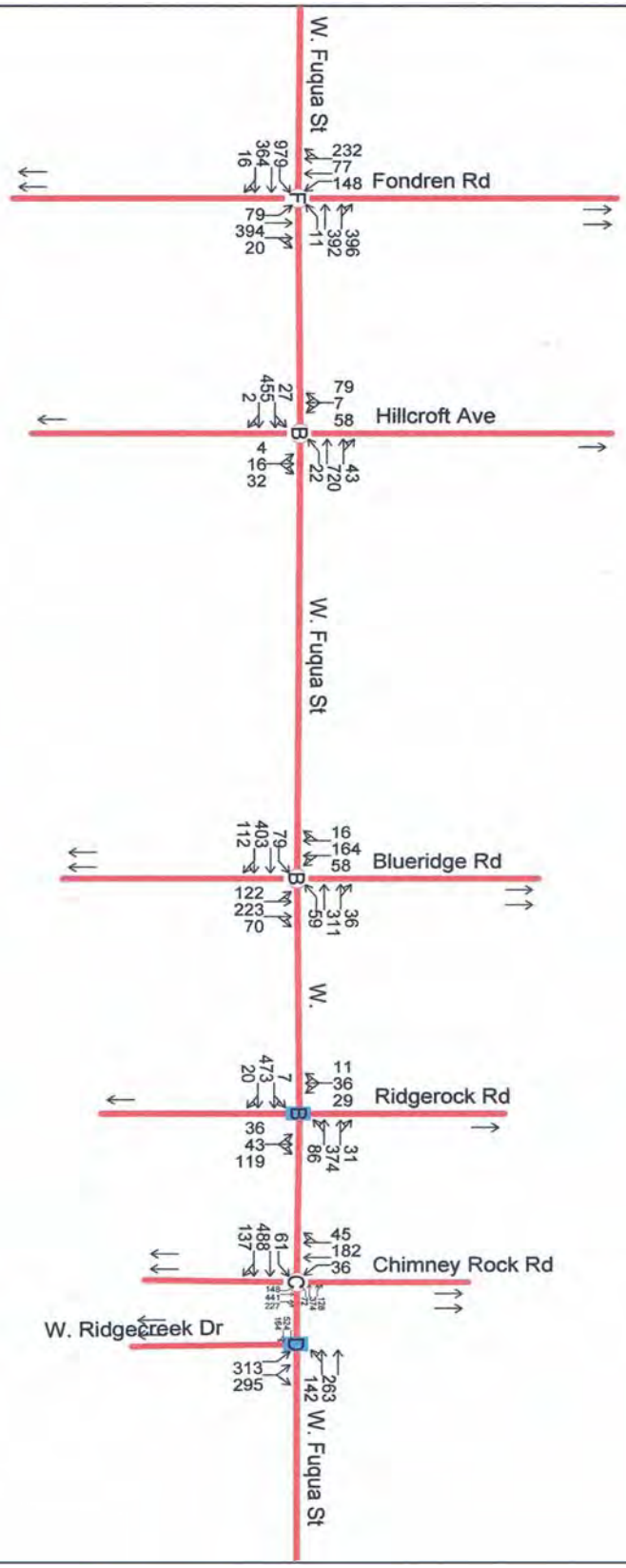

FIGURE-5
Scenario 2-AM 2035 Analysis, LOS, Volumes & Lane Configuration

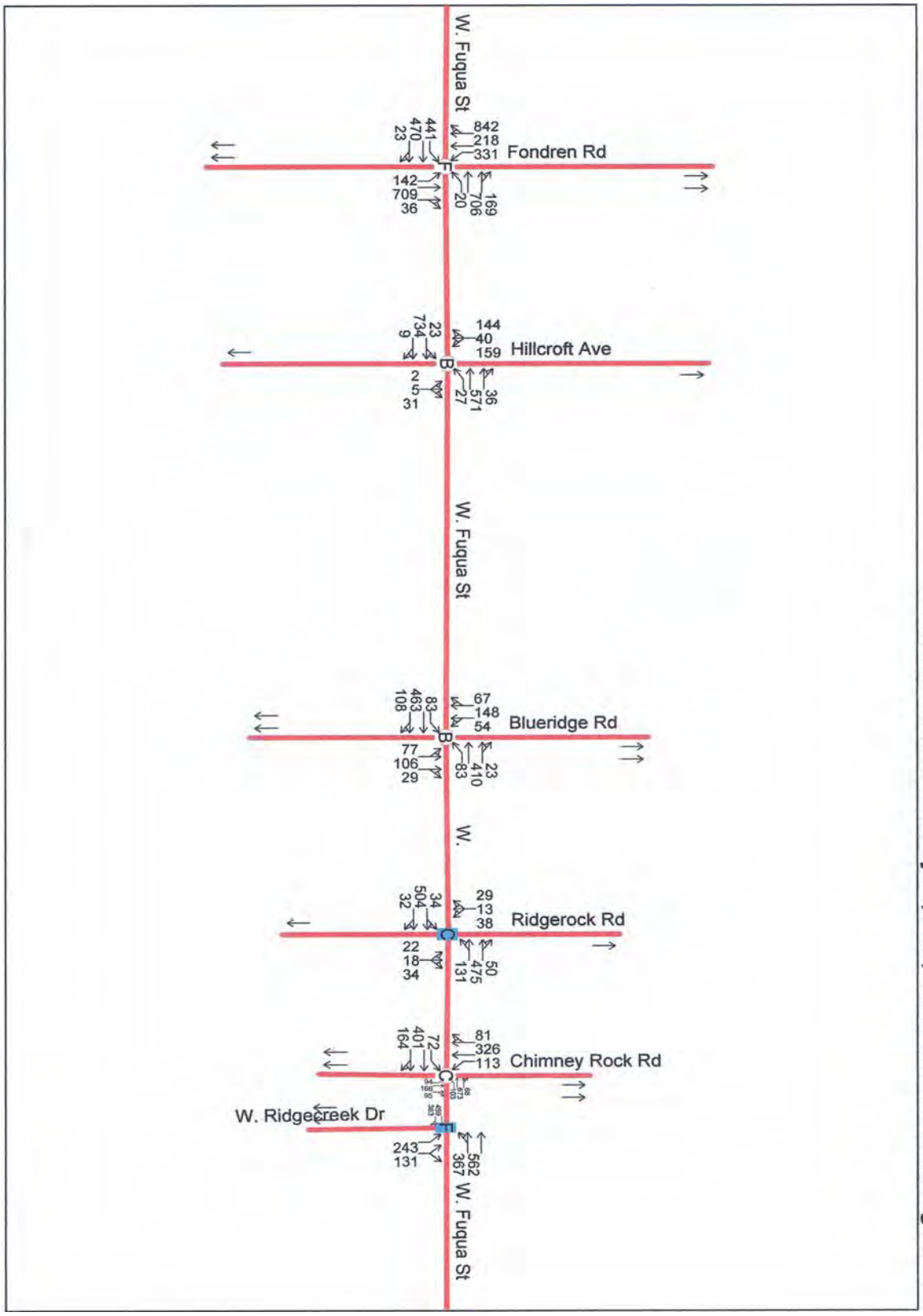

FIGURE-6
Scenario 2-PM 2035 Analysis, LOS, Volumes & Lane Configuration

E. 2035 LEVEL OF SERVICE EVALUATION W/IMPROVEMENTS (SCENARIO-3)

The level of service analysis for Scenario 3 was performed for all the signalized and STOP control Intersections. The following two intersections found to be severely impacted due to a heavy 2035 projected traffic demand:

Intersection #1, W. Fuqua St at Fondren Rd
Intersection #6, W. Fuqua St at W. Ridgecreek Dr

The Peak Hour Delay Assessment for Intersection #1, W. Fuqua St at Fondren Rd

Morning Peak Hour Delay:
The delay problem during morning peak hour is due to a heavy projected future demand on the eastbound W. Fuqua St approach for the left turning traffic as the existing 2013 left turning traffic increases from 544 vph to 979 vph for the year 2035. This increase resulted for level of service "F".

Evening Peak Hour Delay:
The delay problem during evening peak hour is also due to a heavy projected future demand on the southbound Fondren St approach for the right turning traffic as the existing 2013 right turning traffic increases from 468 vph to 842 vph for the year 2035. This increase in traffic resulted for level of service "F".

Requirements for an Exclusive Right Turn Lane and Double Left Turn Lane:

EXCLUSIVE RIGHT TURN LANE
In general, a right turn lane is warranted at a signalized intersection when the right turning traffic volume exceeds 300 vph. In analyzing the traffic data, it is found out that the following approaches at the subject intersections satisfy the criteria:

DOUBLE LEFT TURN LANE
The guidelines for considering the double left-turn lanes are provided in Chapter 11 of Traffic Engineering Hand Book by ITE. It says, typically, design volume of 400 vph or more represents a threshold at which double-left turn lanes should be considered.

Based on the above guidelines, both the eastbound W. Fuqua Street approach and the southbound Fondren Road approach satisfied a 2nd left turn lane and an exclusive right turn lane for the referenced approaches respectively.

The Peak Hour Delay Assessment for Intersection #6, W. Fuqua St at W. Ridgecreek Dr

Evening Peak Hour Delay:
The delay problem at this three-way STOP control intersection is basically during evening peak hour and it is due to a heavy projected future demand on both eastbound and westbound

W. Fuqua St approaches. The existing 2013 evening peak hour traffic on eastbound and westbound approaches increases for the 2035 projected evening peak hour condition from 468 vph to 842 vph and 516 vph to 929 vph respectively. This increase in traffic resulted for level of service **"F".**

Recommendations for a Traffic Signal Installation W. Fuqua St at W. Ridgecreek Dr

Our cursory review of the projected 2035 future traffic volumes satisfied the peak hour warrant criteria for installing a traffic signal at this intersection. Therefore, the intersection capacity analysis for this intersection was revised with a traffic signal control. The signal installation at this intersection will improve level of service from "F" to "B" as listed in Table 5 of the report.

Note: A detail traffic signal warrant study with a crash analysis for this intersection is recommended before a decision to install a traffic signal is finalized in the future.

Requirement for an Exclusive Left Turn Lane on EB W. Fuqua St at Hillcroft Ave:

The level of service evaluation for the intersection of W. Fuqua St and Hillcroft Ave was also revised with a proposed dedicated left turn lane on eastbound W. Fuqua St as currently this intersection is missing the left turn lane on the eastbound approach. Even though, there is no deficiency with the current operations, an exclusive left turn lane is recommended to improve safety and through traffic as the through traffic appears to be impacted due to occasional turning traffic.

Table 5 of the report summarizes the 2035 levels of service with improvements as described above for the three signalized intersections

The results show that the levels of service with recommended improvements improve as follows:

Intersection #1, W. Fuqua St at Fondren Rd
The intersection of W. Fuqua St and Fondren Rd improved to an acceptable level of service **"D"** from a failing condition for both the morning and evening peak hours.

Intersection #6, W. Fuqua St at W. Ridgecreek Dr
The intersection of W. Fuqua St and W. Ridgecreek Dr improved to level of service **"B"** from a failing condition for both the morning and evening peak hours.

Intersection #2, W. Fuqua St at Hillcroft Ave
This intersection maintained level of service **"B"** with the addition of exclusive left turn lane on the eastbound W. Fuqua St as the turn lane is needed to improve the through progression.

NOTE:

The remaining intersections were not needed to be revised as each of the remaining intersections found to be at level of service "C" or better. The results of intersection capacity

analyses are listed in **Tables 3, 4 and 5** of the report. . The detail LOS computations (SYNCHRO outputs) for each intersection are contained in the **Appendix B**.

Table 5 - Level of Service (LOS) Analysis Summary_ 2035 W/Improvements

Intersection #1 Signalized Intersection at W. Fuqua St at Fondren Rd				
APPROACH	**AM Peak Hour**		**PM Peak Hour**	
	LOS	**Delay (Sec/Veh)**	**LOS**	**Delay (Sec/Veh)**
NB Fondren Rd Approach	D	37.3	**D**	49.9
SB Fondren Rd Approach	C	26.1	**C**	30.4
EB W. Fuqua St Approach	D	38.5	D	52.2
WB W. Fuqua St Approach	D	49.7	D	54.7
Intersection LOS	**D**	**39.4**	**D**	**44.8**

Intersection #2 Signalized Intersection at W. Fuqua St at Hillcroft Ave				
APPROACH	**AM Peak Hour**		**PM Peak Hour**	
	LOS	**Delay (Sec/Veh)**	**LOS**	**Delay (Sec/Veh)**
NB Hillcroft Ave Approach	A	8.3	**A**	8.2
SB Fondren Rd Approach	A	8.4	**C**	21.1
EB W. Fuqua St Approach	B	18.1	B	14.9
WB W. Fuqua St Approach	C	22.9	B	11.9
Intersection LOS	**B**	**19.4**	**B**	**14.9**

Intersection #6 Signalized Intersection at W. Fuqua St at W. Ridgecreek Dr				
APPROACH	**AM Peak Hour**		**PM Peak Hour**	
	LOS	**Delay (Sec/Veh)**	**LOS**	**Delay (Sec/Veh)**
NB W. Ridgecreek Dr Approach	A	8.2	B	14.6
EB W. Fuqua St Approach	C	21.5	B	18.3
WBW. Fuqua St Approach	B	12.3	B	12.5
Intersection LOS	**B**	**14.5**	**B**	**15.2**

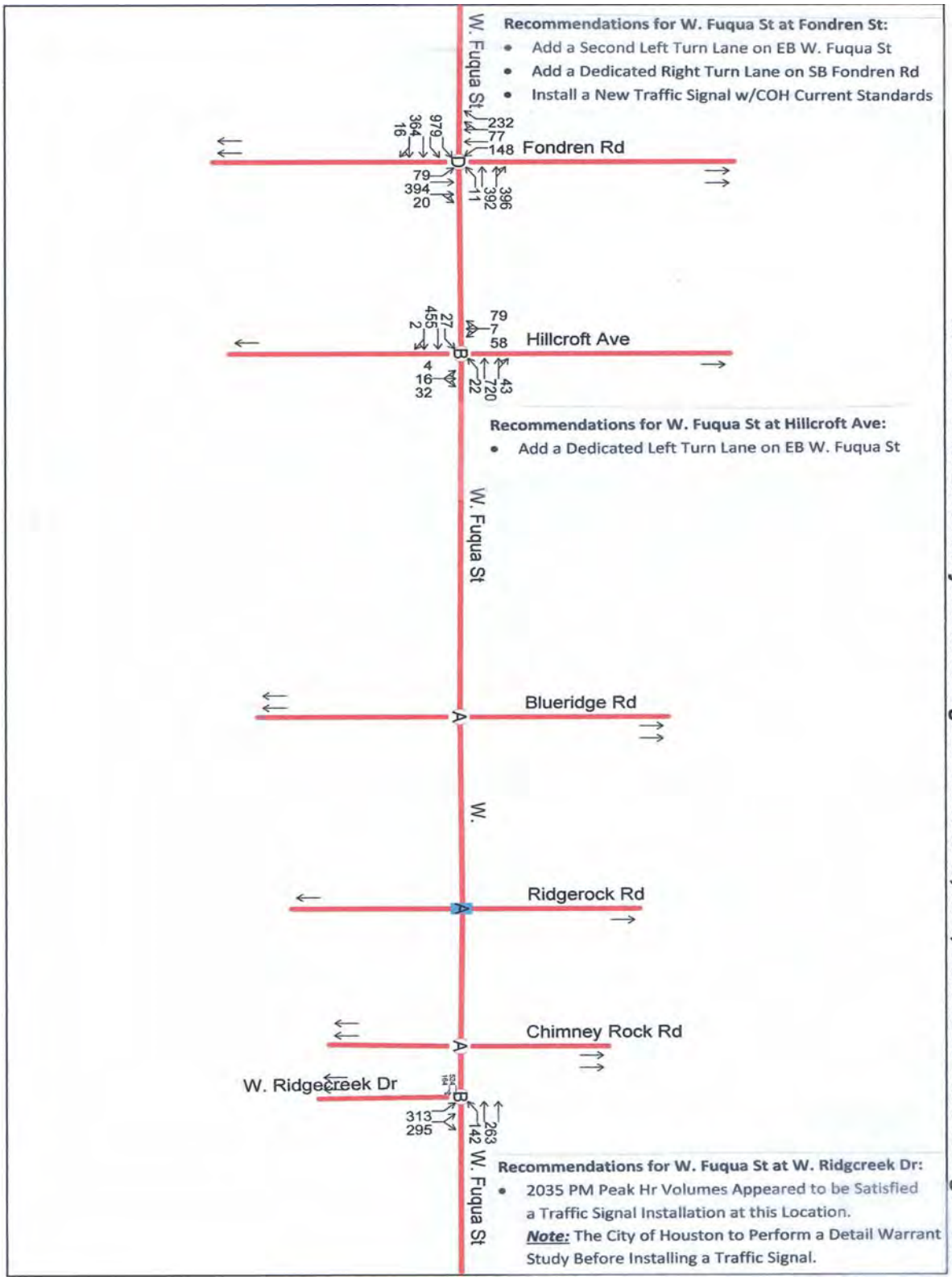

FIGURE-7
Scenario 3-AM 2035 Analysis with Mitigation Measures, LOS, Volumes & Lane Configuration

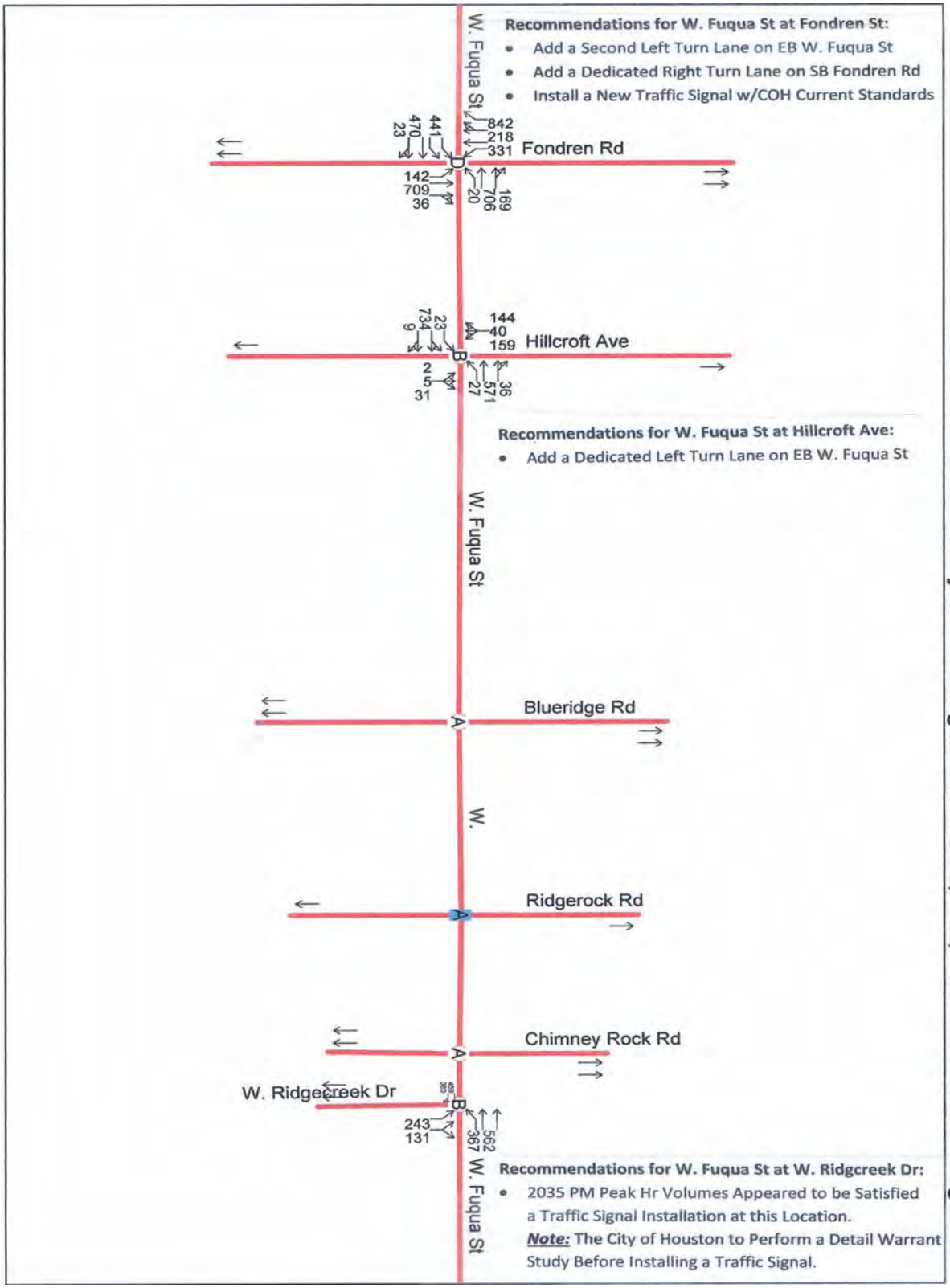

FIGURE-8
Scenario 3-PM 2035 Analysis with Mitigation Measures, LOS, Volumes & Lane Configuration

V. CONCLUSIONS AND RECOMMENDATIONS

KEY FINDINGS

In conducting the traffic analyses, the following findings and conclusions were made:

The level of service analysis for Scenarios 1, 2 and 3 was performed utilizing traffic analysis software SYNCHRO for all the signalized and STOP control Intersections. All the intersections for Scenarios 1, 2 and 3 found to be operating at level of service "C" or better except the following two intersections under Scenario 3 as these intersections found to be operating at level of service **"F"** to a heavy 2035 projected traffic demand:

Intersection #1, W. Fuqua St at Fondren Rd
Intersection #6, W. Fuqua St at W. Ridgecreek Dr

The Peak Hour Delay Assessment for Intersection #1, W. Fuqua St at Fondren Rd

Morning Peak Hour Delay:
The delay problem during morning peak hour is due to a heavy projected future demand on the eastbound W. Fuqua St approach for the left turning traffic as the existing 2013 left turning traffic increases from 544 vph to 979 vph for the year 2035. This increase resulted for level of service **"F".**

Evening Peak Hour Delay:
The delay problem during evening peak hour is also due to a heavy projected future demand on the southbound Fondren St approach for the right turning traffic as the existing 2013 right turning traffic increases from 468 vph to 842 vph for the year 2035. This increase in traffic resulted for level of service **"F".**

Requirements for an Exclusive Right Turn Lane and Double Left Turn Lane:

EXCLUSIVE RIGHT TURN LANE
In general, a right turn lane is warranted at a signalized intersection when the right turning traffic volume exceeds 300 vph. In analyzing the traffic data, it is found out that the following approaches at the subject intersections satisfy the criteria:

DOUBLE LEFT TURN LANE
The guidelines for considering the double left-turn lanes are provided in Chapter 11 of Traffic Engineering Hand Book by ITE. It says, typically, design volume of 400 vph or more represents a threshold at which double-left turn lanes should be considered.

Based on the above guidelines, both the eastbound W. Fuqua Street approach and the southbound Fondren Road approach satisfied a 2nd left turn lane and an exclusive right turn lane for the referenced approaches respectively.

The Peak Hour Delay Assessment for Intersection #6, W. Fuqua St at W. Ridgecreek Dr

Evening Peak Hour Delay:
The delay problem at this three-way STOP control intersection is basically during evening peak hour and it is due to a heavy projected future demand on both eastbound and westbound W. Fuqua St approaches. The existing 2013 evening peak hour traffic on eastbound and westbound approaches increases for the 2035 projected evening peak hour condition from 468 vph to 842 vph and 516 vph to 929 vph respectively. This increase in traffic resulted for level of service **"F".**

Recommendations for a Traffic Signal Installation at W. Fuqua St at W. Ridgecreek Dr

Our cursory review of the projected 2035 future traffic volumes satisfied the peak hour warrant criteria for installing a traffic signal at this intersection. Therefore, the intersection capacity analysis for this intersection was revised with a traffic signal control. The signal installation at this intersection will improve level of service from "F" to "B" as listed in Table 5 of the report.

Note: A detail traffic signal warrant study with a crash analysis for this intersection is recommended before a decision to install a traffic signal is finalized in the future.

Requirement for an Exclusive Left Turn Lane on EB W. Fuqua St at Hillcroft Ave:

The level of service evaluation for the intersection of W. Fuqua St and Hillcroft Ave was also revised with a proposed dedicated left turn lane on eastbound W. Fuqua St as currently this intersection is missing the left turn lane on the eastbound approach. Even though, there is no deficiency with the current operations, an exclusive left turn lane is recommended to improve safety and through traffic as the through traffic appears to be impacted due to occasional turning traffic.

Table 5 of the report summarizes the 2035 levels of service with improvements as described above for the three signalized intersections

The results show that the levels of service with recommended improvements improve as follows:

Intersection #1, W. Fuqua St at Fondren Rd
The intersection of W. Fuqua St and Fondren Rd improved to an acceptable level of service **"D"** from a failing condition for both the morning and evening peak hours.

Intersection #6, W. Fuqua St at W. Ridgecreek Dr

The intersection of W. Fuqua St and W. Ridgecreek Dr improved to level of service **"B"** from a failing condition for both the morning and evening peak hours.

Intersection #2, W. Fuqua St at Hillcroft Ave
This intersection maintained level of service **"B"** with the addition of exclusive left turn lane on the eastbound W. Fuqua St as the turn lane is needed to improve the through progression.

NOTE:
The remaining intersections were not needed to be revised as each of the remaining intersections found to be at level of service "C" or better. The results of intersection capacity analyses are listed in **Tables 3, 4 and 5** of the report. . The detail LOS computations (SYNCHRO outputs) for each intersection are contained in the **Appendix B**.

SUMMARY OF FINAL RECOMMENDATIONS

Based on the results of the analysis and findings of this study, the following recommendations are made for the study corridor and each of the study intersections based on the current safety and operational issues and also to address the projected future traffic demand:

W. Fuqua Street Corridor

Based on the above City criteria as discussed in Section IV of the report, it is assumed that the study corridor will be operating at acceptable level of service "D" for pretty much throughout the study corridor for the 2035 projected year.

Intersection #1, W. Fuqua Street at Fondren Road (Signalized Intersection):

The following improvements are recommended for Intersection #1:

- Add 2nd left turn lane on eastbound W. Fuqua St with a proposed storage of 300 ft.
- Add a dedicated right turn lane on southbound Fondren Rd with a proposed storage of 300 ft. and revise the middle lane to provide a shared left and thru movement.
- Install a new mast arm signal system as existing does not meet the City standards
- Install ADA wheelchair ramps and crosswalk pavement markings
- Install Pedestrian Count Down signal system
- Install Audible Pedestrian Signals (APS) settings.
- Optimize signal phasing & timings.

Intersection #2, W. Fuqua Street at Hillcroft Ave:

Based on the current safety and operational deficiencies, the following improvements are recommended for Intersection #2:

- Add an exclusive left turn lane on eastbound W. Fuqua St with minimum 100-150 ft. storage.
- Install a separate left turn lane signal indication (a three sections signal head on existing mast arm facing the eastbound traffic)
- Install ADA wheelchair ramps and crosswalk pavement markings
- Install Pedestrian Count Down signal system
- Install Audible Pedestrian Signals (APS) settings.
- Optimize signal phasing & timings.

Intersection #3, W. Fuqua Street at Hillcroft Ave:

Based on the current safety and operational deficiencies, the following improvements are recommended for Intersection #3:

- Install mast arm mounted street sign for eastbound traffic.
- Install ADA wheelchair ramps and crosswalk pavement markings.
- Install Pedestrian Count Down signal system.
- Install Audible Pedestrian Signals (APS) settings.
- Optimize signal phasing & timings.

Intersection #4, W. Fuqua Street at Ridgerock Road (ALL-WAY STOP):

Based on the current safety and operational deficiencies, the following improvements are recommended for Intersection #4:

- Install ADA wheelchair ramps and crosswalk pavement markings.
- Install a dedicated left turn lane on both EB and WB approaches with minimum 75-100 ft. storage.

NOTE: The City may need to consider converting to a minor approach STOP control intersection in the future to improve mobility along the major corridor.

Intersection #5, W. Fuqua Street at Chimney Rock Road:

Based on the current safety and operational deficiencies, the following improvements are recommended for Intersection #5:

- Install Pedestrian Count Down signal system.
- Install Audible Pedestrian Signals (APS) settings.
- Optimize signal phasing & timings.

Intersection #6, W. Fuqua Street at W. Ridgecreek Drive:

Based on the current safety and operational deficiencies, the following improvements are recommended for Intersection #6:

- Consider installing a traffic signal at this intersection with a Pedestrian Count Down signal system.
- Install Audible Pedestrian Signals (APS) settings with the new signal system.
- Optimize signal phasing & timings.

General Statement for Interconnecting Traffic Signals along W. Fuqua Corridor:

It is recommended to interconnect all the existing and future traffic signal along the corridor to improve safety and mobility.

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APPENDIX

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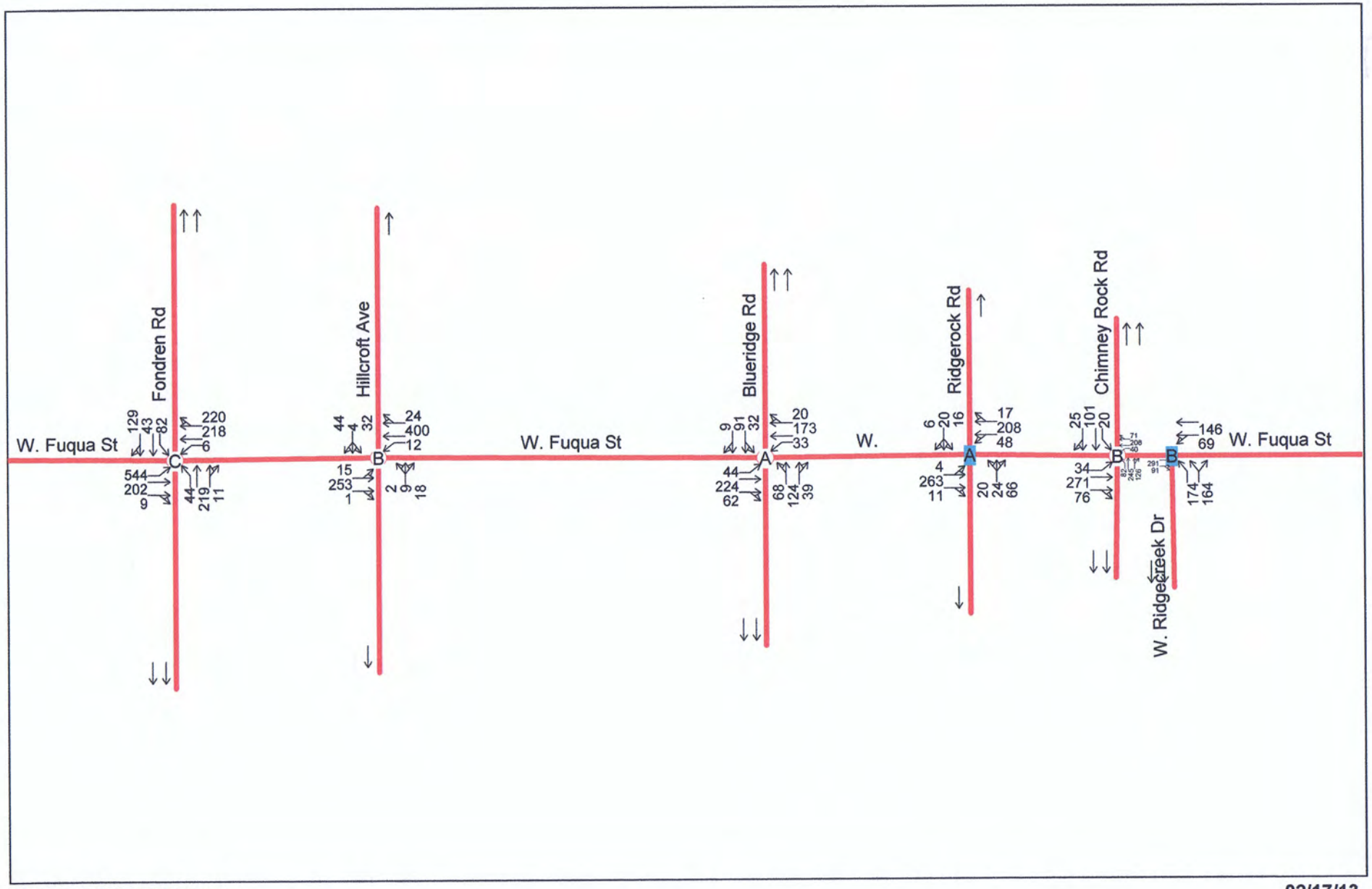
APPENDIX B
SYNCHRO OUTPUTS/PRINTOUTS



W. Fuqa Street Network

W. Fuqua Street Intersection Capacity Analysis

02/17/13

Scenario 1-AM 2013 Volumes, Lane Configuration and Intersection Level of Service

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	200		0	200		0	200		0
Storage Lanes	1		0	1		0	1		0	1		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50		50	50	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.993			0.925			0.993			0.888	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3514	0	1770	3274	0	1770	3514	0	1770	3143	0
Flt Permitted	0.437			0.608			0.634			0.560		
Satd. Flow (perm)	814	3514	0	1133	3274	0	1181	3514	0	1043	3143	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		7			239			5			140	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		1888			1696			1888			2112	
Travel Time (s)		36.8			33.0			28.6			32.0	
Volume (vph)	544	202	9	6	218	220	44	219	11	82	43	129
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	591	220	10	7	237	239	48	238	12	89	47	140
Lane Group Flow (vph)	591	230	0	7	476	0	48	250	0	89	187	0
Turn Type	pm+pt			pm+pt			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases	4			8			2			6		
Detector Phases	7	4		3	8		2	2		6	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	8.0	20.0		8.0	20.0		20.0	20.0		20.0	20.0	
Total Split (s)	18.0	46.0	0.0	18.0	46.0	0.0	26.0	26.0	0.0	26.0	26.0	0.0
Total Split (%)	20.0%	51.1%	0.0%	20.0%	51.1%	0.0%	28.9%	28.9%	0.0%	28.9%	28.9%	0.0%
Maximum Green (s)	14.0	42.0		14.0	42.0		22.0	22.0		22.0	22.0	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		Max	Max		Max	Max	
Walk Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0		0	0		0	0	
Act Effct Green (s)	27.9	26.1		15.7	9.9		22.1	22.1		22.1	22.1	
Actuated g/C Ratio	0.48	0.45		0.24	0.17		0.38	0.38		0.38	0.38	
v/c Ratio	0.95	0.15		0.02	0.63		0.11	0.19		0.22	0.15	
Control Delay	41.0	10.1		10.2	11.1		13.7	13.0		15.3	5.0	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	41.0	10.1		10.2	11.1		13.7	13.0		15.3	5.0	
LOS	D	B		B	B		B	B		B	A	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		32.4			11.1			13.1			8.3	
Approach LOS		C			B			B			A	

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 58
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.95
Intersection Signal Delay: 20.3 — Intersection LOS: C
Intersection Capacity Utilization 67.5% — ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 3: W. Fuqua St & Fondren Rd

ø2	ø3	ø4
26 s	18 s	46 s
ø6	ø7	ø8
26 s	18 s	46 s

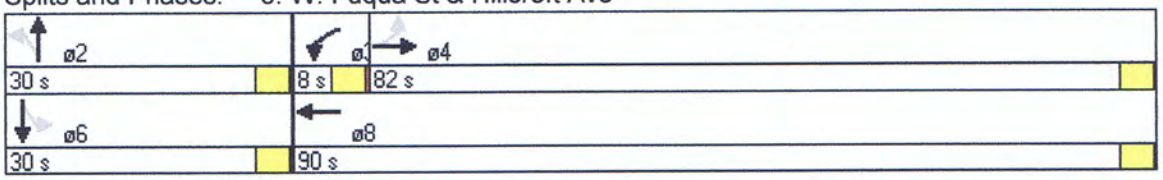
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	100		0	0		0	0		0
Storage Lanes	0		0	1		0	0		0	0		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50		50	50	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.999			0.992			0.916			0.926	
Flt Protected		0.997		0.950				0.997			0.980	
Satd. Flow (prot)	0	3525	0	1770	3511	0	0	1701	0	0	1690	0
Flt Permitted		0.922		0.950				0.991			0.889	
Satd. Flow (perm)	0	3260	0	1770	3511	0	0	1691	0	0	1533	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			13			20			47	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		35			35			35			35	
Link Distance (ft)		1696			3216			1776			2064	
Travel Time (s)		33.0			62.6			34.6			40.2	
Volume (vph)	15	253	1	12	400	24	2	9	18	32	4	44
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	16	275	1	13	435	26	2	10	20	35	4	48
Lane Group Flow (vph)	0	292	0	13	461	0	0	32	0	0	87	0
Turn Type	Perm			Prot			Perm			Perm		
Protected Phases		4		3	8			2			6	
Permitted Phases	4						2			6		
Detector Phases	4	4		3	8		2	2		6	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	20.0	20.0		8.0	20.0		20.0	20.0		20.0	20.0	
Total Split (s)	82.0	82.0	0.0	8.0	90.0	0.0	30.0	30.0	0.0	30.0	30.0	0.0
Total Split (%)	68.3%	68.3%	0.0%	6.7%	75.0%	0.0%	25.0%	25.0%	0.0%	25.0%	25.0%	0.0%
Maximum Green (s)	78.0	78.0		4.0	86.0		26.0	26.0		26.0	26.0	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	
Lead/Lag	Lag	Lag		Lead								
Lead-Lag Optimize?	Yes	Yes		Yes								
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		Max	Max		Max	Max	
Walk Time (s)	5.0	5.0			5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)	11.0	11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0			0		0	0		0	0	
Act Effct Green (s)		10.5		4.0	11.9			26.2			26.2	
Actuated g/C Ratio		0.23		0.08	0.26			0.57			0.57	
v/c Ratio		0.39		0.10	0.50			0.03			0.10	
Control Delay		15.7		25.2	14.0			4.3			4.0	
Queue Delay		0.0		0.0	0.0			0.0			0.0	
Total Delay		15.7		25.2	14.0			4.3			4.0	
LOS		B		C	B			A			A	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		15.7			14.3			4.3			4.0	
Approach LOS		B			B			A			A	

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 46.2
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.50
Intersection Signal Delay: 13.4 — Intersection LOS: B
Intersection Capacity Utilization 36.3% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 5: W. Fuqua St & Hillcroft Ave



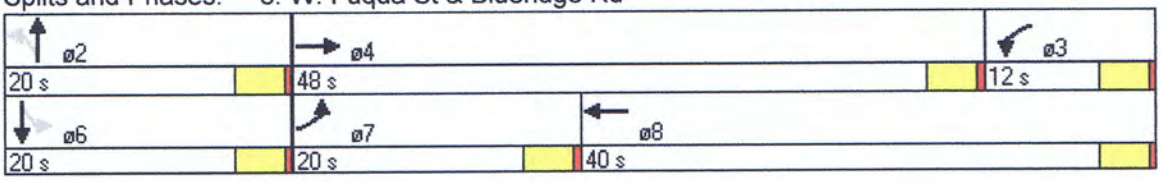
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		0	150		0	0		0	0		0
Storage Lanes	1		0	1		0	0		0	0		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50		50	50	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Frt		0.968			0.984			0.975			0.990	
Flt Protected	0.950			0.950				0.985			0.988	
Satd. Flow (prot)	1770	3426	0	1770	3483	0	0	3399	0	0	3462	0
Flt Permitted	0.950			0.950				0.821			0.842	
Satd. Flow (perm)	1770	3426	0	1770	3483	0	0	2833	0	0	2950	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		67			20			26			9	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		35			30			30			30	
Link Distance (ft)		3216			1696			1552			1600	
Travel Time (s)		62.6			38.5			35.3			36.4	
Volume (vph)	44	224	62	33	173	20	68	124	39	32	91	9
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	48	243	67	36	188	22	74	135	42	35	99	10
Lane Group Flow (vph)	48	310	0	36	210	0	0	251	0	0	144	0
Turn Type	Prot			Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		
Detector Phases	7	4		3	8		2	2		6	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	8.0	20.0		8.0	20.0		20.0	20.0		20.0	20.0	
Total Split (s)	20.0	48.0	0.0	12.0	40.0	0.0	20.0	20.0	0.0	20.0	20.0	0.0
Total Split (%)	25.0%	60.0%	0.0%	15.0%	50.0%	0.0%	25.0%	25.0%	0.0%	25.0%	25.0%	0.0%
Maximum Green (s)	16.0	44.0		8.0	36.0		16.0	16.0		16.0	16.0	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	
Lead/Lag	Lead	Lead		Lag	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		Max	Max		Max	Max	
Walk Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0		0	0		0	0	
Act Effct Green (s)	6.6	10.1		6.4	7.9			20.4			20.4	
Actuated g/C Ratio	0.15	0.26		0.14	0.20			0.55			0.55	
v/c Ratio	0.18	0.33		0.14	0.29			0.16			0.09	
Control Delay	16.7	9.0		19.0	12.3			7.8			8.2	
Queue Delay	0.0	0.0		0.0	0.0			0.0			0.0	
Total Delay	16.7	9.0		19.0	12.3			7.8			8.2	
LOS	B	A		B	B			A			A	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		10.0			13.3			7.8			8.2	
Approach LOS		B			B			A			A	

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 37.3
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.33
Intersection Signal Delay: 10.0 — Intersection LOS: A
Intersection Capacity Utilization 35.2% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 8: W. Fuqua St & Blueridge Rd



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	4	263	11	48	208	17	20	24	66	16	20	6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	4	286	12	52	226	18	22	26	72	17	22	7

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total (vph)	147	155	165	132	120	46
Volume Left (vph)	4	0	52	0	22	17
Volume Right (vph)	0	12	0	18	72	7
Hadj (s)	0.05	-0.02	0.19	-0.06	-0.29	0.02
Departure Headway (s)	5.3	5.2	5.5	5.2	5.0	5.5
Degree Utilization, x	0.22	0.23	0.25	0.19	0.17	0.07
Capacity (veh/h)	655	660	633	665	655	590
Control Delay (s)	8.6	8.6	9.1	8.2	9.0	8.9
Approach Delay (s)	8.6		8.7		9.0	8.9
Approach LOS	A		A		A	A

Intersection Summary			
Delay	8.7		
HCM Level of Service	A		
Intersection Capacity Utilization	32.4%	ICU Level of Service	A
Analysis Period (min)	15		

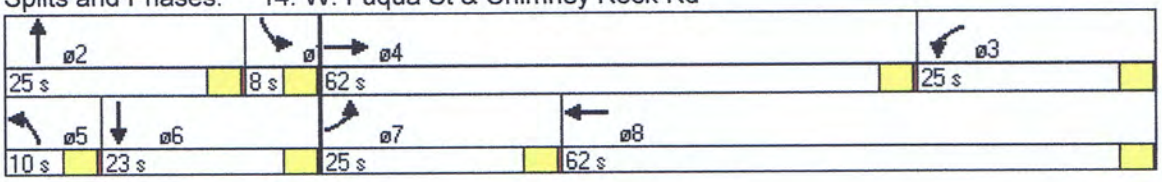
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		0	150		0	150		0	150		0
Storage Lanes	1		0	1		0	1		0	1		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50		50	50	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.967			0.962			0.949			0.970	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3422	0	1770	3405	0	1770	3359	0	1770	3433	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	3422	0	1770	3405	0	1770	3359	0	1770	3433	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		42			55			66			21	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1216			448			1008			1136	
Travel Time (s)		27.6			10.2			22.9			25.8	
Volume (vph)	34	271	76	40	208	71	82	245	126	20	101	25
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	37	295	83	43	226	77	89	266	137	22	110	27
Lane Group Flow (vph)	37	378	0	43	303	0	89	403	0	22	137	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Detector Phases	7	4		3	8		5	2		1	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	8.0	20.0		8.0	20.0		8.0	20.0		8.0	20.0	
Total Split (s)	25.0	62.0	0.0	25.0	62.0	0.0	10.0	25.0	0.0	8.0	23.0	0.0
Total Split (%)	20.8%	51.7%	0.0%	20.8%	51.7%	0.0%	8.3%	20.8%	0.0%	6.7%	19.2%	0.0%
Maximum Green (s)	21.0	58.0		21.0	58.0		6.0	21.0		4.0	19.0	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	
Lead/Lag	Lead	Lead		Lag	Lag		Lead	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		None	Max		None	Max	
Walk Time (s)		5.0			5.0			5.0			5.0	
Flash Dont Walk (s)		11.0			11.0			11.0			11.0	
Pedestrian Calls (#/hr)		0			0			0			0	
Act Effct Green (s)	6.7	10.4		6.9	10.5		6.2	28.5		4.1	19.5	
Actuated g/C Ratio	0.11	0.20		0.12	0.20		0.12	0.54		0.07	0.37	
v/c Ratio	0.18	0.53		0.21	0.42		0.43	0.22		0.18	0.11	
Control Delay	25.0	17.7		24.9	15.8		32.8	8.3		32.5	12.4	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	25.0	17.7		24.9	15.8		32.8	8.3		32.5	12.4	
LOS	C	B		C	B		C	A		C	B	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		18.4			16.9			12.8			15.1	
Approach LOS		B			B			B			B	

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 52.5
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.53
Intersection Signal Delay: 15.7 — Intersection LOS: B
Intersection Capacity Utilization 40.7% — ICU Level of Service A
Analysis Period (min) 15

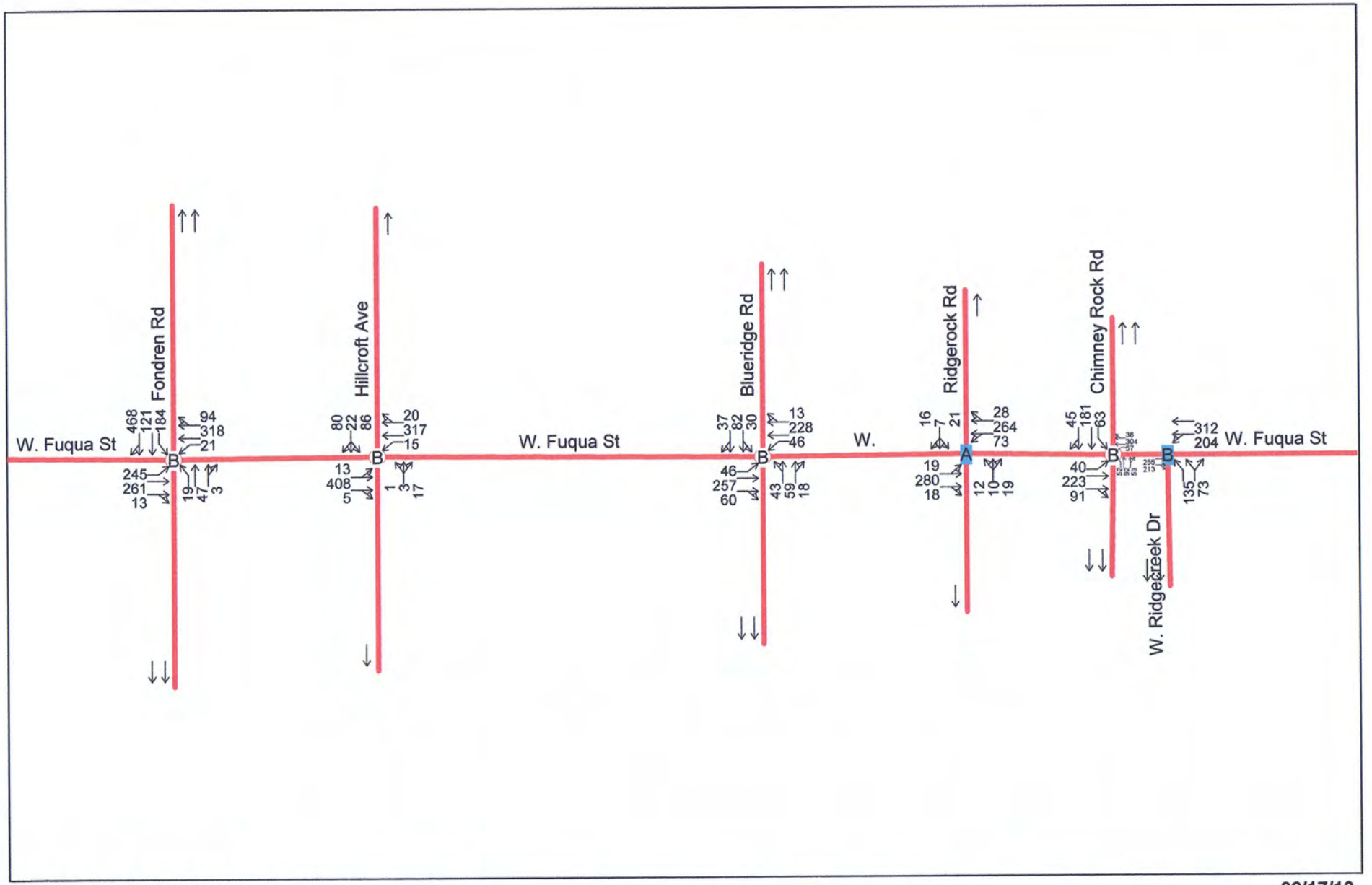
Splits and Phases: 14: W. Fuqua St & Chimney Rock Rd



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Stop			Stop	Stop	
Volume (vph)	291	91	69	146	174	164
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	316	99	75	159	189	178

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total (vph)	211	204	128	106	126	241
Volume Left (vph)	0	0	75	0	126	63
Volume Right (vph)	0	99	0	0	0	178
Hadj (s)	0.03	-0.30	0.33	0.03	0.53	-0.35
Departure Headway (s)	6.0	5.6	6.5	6.2	6.7	5.8
Degree Utilization, x	0.35	0.32	0.23	0.18	0.23	0.39
Capacity (veh/h)	577	613	527	552	513	591
Control Delay (s)	11.0	10.1	10.2	9.4	10.5	11.2
Approach Delay (s)	10.5		9.8		11.0	
Approach LOS	B		A		B	

Intersection Summary			
Delay	10.5		
HCM Level of Service	B		
Intersection Capacity Utilization	37.1%	ICU Level of Service	A
Analysis Period (min)	15		



W. Fuqa Street Network

W. Fuqua Street Intersection Capacity Analysis

02/17/13

Scenario 1-PM 2013 Volumes, Lane Configuration and Intersection Level of Service

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	200		0	200		0	200		0
Storage Lanes	1		0	1		0	1		0	1		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50		50	50	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.993			0.966			0.992			0.881	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3514	0	1770	3419	0	1770	3511	0	1770	3118	0
Flt Permitted	0.451			0.557			0.203			0.720		
Satd. Flow (perm)	840	3514	0	1038	3419	0	378	3511	0	1341	3118	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		7			52			3			509	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		1888			1696			1888			2112	
Travel Time (s)		36.8			33.0			28.6			32.0	
Volume (vph)	245	261	13	21	318	94	19	47	3	184	121	468
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	266	284	14	23	346	102	21	51	3	200	132	509
Lane Group Flow (vph)	266	298	0	23	448	0	21	54	0	200	641	0
Turn Type	pm+pt			pm+pt			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases	4			8			2			6		
Detector Phases	7	4		3	8		2	2		6	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	8.0	20.0		8.0	20.0		20.0	20.0		20.0	20.0	
Total Split (s)	19.0	51.0	0.0	19.0	51.0	0.0	30.0	30.0	0.0	30.0	30.0	0.0
Total Split (%)	19.0%	51.0%	0.0%	19.0%	51.0%	0.0%	30.0%	30.0%	0.0%	30.0%	30.0%	0.0%
Maximum Green (s)	15.0	47.0		15.0	47.0		26.0	26.0		26.0	26.0	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		Max	Max		Max	Max	
Walk Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0		0	0		0	0	
Act Effct Green (s)	29.7	25.8		18.9	12.7		26.2	26.2		26.2	26.2	
Actuated g/C Ratio	0.46	0.40		0.27	0.20		0.41	0.41		0.41	0.41	
v/c Ratio	0.46	0.21		0.07	0.62		0.14	0.04		0.36	0.41	
Control Delay	13.0	13.3		10.8	21.1		17.3	12.9		17.3	4.3	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	13.0	13.3		10.8	21.1		17.3	12.9		17.3	4.3	
LOS	B	B		B	C		B	B		B	A	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		13.2			20.6			14.1			7.4	
Approach LOS		B			C			B			A	

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 64
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.62
Intersection Signal Delay: 12.5 — Intersection LOS: B
Intersection Capacity Utilization 53.9% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 3: W. Fuqua St & Fondren Rd

ø2	ø3	ø4
30 s	19 s	51 s
ø6	ø7	ø8
30 s	19 s	51 s

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	100		0	0		0	0		0
Storage Lanes	0		0	1		0	0		0	0		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50		50	50	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.998			0.991			0.890			0.942	
Flt Protected		0.998		0.950				0.998			0.978	
Satd. Flow (prot)	0	3525	0	1770	3507	0	0	1655	0	0	1716	0
Flt Permitted		0.940		0.950				0.994			0.858	
Satd. Flow (perm)	0	3320	0	1770	3507	0	0	1648	0	0	1506	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			11			18			41	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		35			35			35			35	
Link Distance (ft)		1696			3216			1776			2064	
Travel Time (s)		33.0			62.6			34.6			40.2	
Volume (vph)	13	408	5	15	317	20	1	3	17	86	22	80
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	14	443	5	16	345	22	1	3	18	93	24	87
Lane Group Flow (vph)	0	462	0	16	367	0	0	22	0	0	204	0
Turn Type	Perm			Prot			Perm			Perm		
Protected Phases		4		3	8			2			6	
Permitted Phases	4						2			6		
Detector Phases	4	4		3	8		2	2		6	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	20.0	20.0		8.0	20.0		20.0	20.0		20.0	20.0	
Total Split (s)	42.0	42.0	0.0	20.0	62.0	0.0	38.0	38.0	0.0	38.0	38.0	0.0
Total Split (%)	42.0%	42.0%	0.0%	20.0%	62.0%	0.0%	38.0%	38.0%	0.0%	38.0%	38.0%	0.0%
Maximum Green (s)	38.0	38.0		16.0	58.0		34.0	34.0		34.0	34.0	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	
Lead/Lag	Lag	Lag		Lead								
Lead-Lag Optimize?	Yes	Yes		Yes								
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		Max	Max		Max	Max	
Walk Time (s)	5.0	5.0			5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)	11.0	11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0			0		0	0		0	0	
Act Effct Green (s)		13.1		6.1	14.9			34.6			34.6	
Actuated g/C Ratio		0.23		0.09	0.26			0.60			0.60	
v/c Ratio		0.61		0.10	0.40			0.02			0.22	
Control Delay		20.8		29.3	16.5			4.8			6.8	
Queue Delay		0.0		0.0	0.0			0.0			0.0	
Total Delay		20.8		29.3	16.5			4.8			6.8	
LOS		C		C	B			A			A	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		20.8			17.0			4.8			6.8	
Approach LOS		C			B			A			A	

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 57.7
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.61
Intersection Signal Delay: 16.4 — Intersection LOS: B
Intersection Capacity Utilization 45.0% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 5: W. Fuqua St & Hillcroft Ave

ø2	ø3	ø4
38 s	20 s	42 s
ø6	ø8	
38 s	62 s	

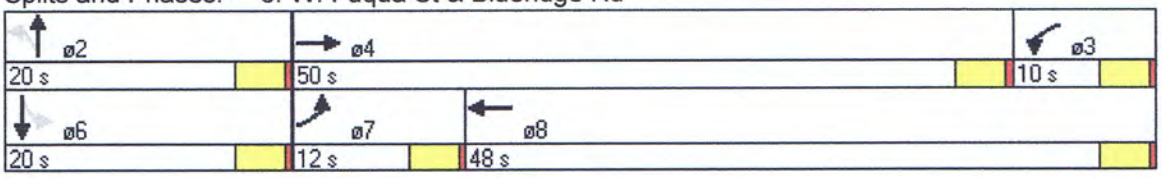
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		0	150		0	0		0	0		0
Storage Lanes	1		0	1		0	0		0	0		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50		50	50	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Frt		0.972			0.992			0.977			0.963	
Flt Protected	0.950			0.950				0.982			0.990	
Satd. Flow (prot)	1770	3440	0	1770	3511	0	0	3396	0	0	3374	0
Flt Permitted	0.950			0.950				0.817			0.881	
Satd. Flow (perm)	1770	3440	0	1770	3511	0	0	2825	0	0	3003	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		59			11			20			40	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		35			30			30			30	
Link Distance (ft)		3216			1696			1552			1600	
Travel Time (s)		62.6			38.5			35.3			36.4	
Volume (vph)	46	257	60	46	228	13	43	59	18	30	82	37
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	50	279	65	50	248	14	47	64	20	33	89	40
Lane Group Flow (vph)	50	344	0	50	262	0	0	131	0	0	162	0
Turn Type	Prot			Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		
Detector Phases	7	4		3	8		2	2		6	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	8.0	20.0		8.0	20.0		20.0	20.0		20.0	20.0	
Total Split (s)	12.0	50.0	0.0	10.0	48.0	0.0	20.0	20.0	0.0	20.0	20.0	0.0
Total Split (%)	15.0%	62.5%	0.0%	12.5%	60.0%	0.0%	25.0%	25.0%	0.0%	25.0%	25.0%	0.0%
Maximum Green (s)	8.0	46.0		6.0	44.0		16.0	16.0		16.0	16.0	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	
Lead/Lag	Lead	Lead		Lag	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		Max	Max		Max	Max	
Walk Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0		0	0		0	0	
Act Effct Green (s)	6.6	8.5		6.2	8.2			17.3			17.3	
Actuated g/C Ratio	0.15	0.23		0.14	0.22			0.46			0.46	
v/c Ratio	0.19	0.42		0.20	0.34			0.10			0.12	
Control Delay	17.7	11.0		19.0	12.9			7.8			7.1	
Queue Delay	0.0	0.0		0.0	0.0			0.0			0.0	
Total Delay	17.7	11.0		19.0	12.9			7.8			7.1	
LOS	B	B		B	B			A			A	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		11.9			13.9			7.8			7.1	
Approach LOS		B			B			A			A	

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 37.6
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.42
Intersection Signal Delay: 11.2 — Intersection LOS: B
Intersection Capacity Utilization 31.4% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 8: W. Fuqua St & Blueridge Rd



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	19	280	18	73	264	28	12	10	19	21	7	16
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	21	304	20	79	287	30	13	11	21	23	8	17

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total (vph)	173	172	223	174	45	48
Volume Left (vph)	21	0	79	0	13	23
Volume Right (vph)	0	20	0	30	21	17
Hadj (s)	0.09	-0.05	0.21	-0.09	-0.19	-0.09
Departure Headway (s)	5.2	5.1	5.3	5.0	5.4	5.5
Degree Utilization, x	0.25	0.24	0.33	0.24	0.07	0.07
Capacity (veh/h)	670	684	659	699	604	592
Control Delay (s)	8.8	8.5	9.7	8.4	8.7	8.9
Approach Delay (s)	8.7		9.1		8.7	8.9
Approach LOS	A		A		A	A

Intersection Summary			
Delay	8.9		
HCM Level of Service	A		
Intersection Capacity Utilization	33.3%	ICU Level of Service	A
Analysis Period (min)	15		

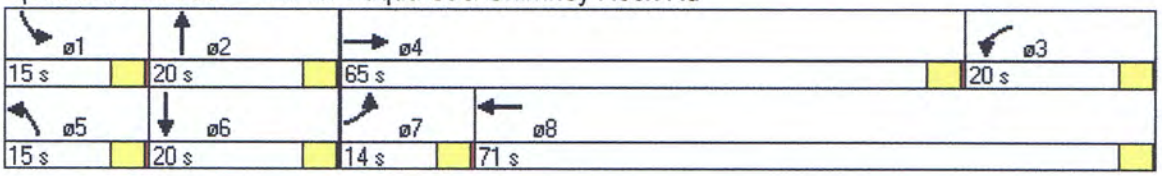
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		0	150		0	150		0	150		0
Storage Lanes	1		0	1		0	1		0	1		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50		50	50	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.956			0.983			0.945			0.970	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3383	0	1770	3479	0	1770	3345	0	1770	3433	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	3383	0	1770	3479	0	1770	3345	0	1770	3433	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		76			18			58			21	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1216			448			1008			1136	
Travel Time (s)		27.6			10.2			22.9			25.8	
Volume (vph)	40	223	91	57	304	38	52	92	53	63	181	45
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	43	242	99	62	330	41	57	100	58	68	197	49
Lane Group Flow (vph)	43	341	0	62	371	0	57	158	0	68	246	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Detector Phases	7	4		3	8		5	2		1	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	8.0	20.0		8.0	20.0		8.0	20.0		8.0	20.0	
Total Split (s)	14.0	65.0	0.0	20.0	71.0	0.0	15.0	20.0	0.0	15.0	20.0	0.0
Total Split (%)	11.7%	54.2%	0.0%	16.7%	59.2%	0.0%	12.5%	16.7%	0.0%	12.5%	16.7%	0.0%
Maximum Green (s)	10.0	61.0		16.0	67.0		11.0	16.0		11.0	16.0	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	
Lead/Lag	Lead	Lead		Lag	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		None	Max		None	Max	
Walk Time (s)		5.0			5.0			5.0			5.0	
Flash Dont Walk (s)		11.0			11.0			11.0			11.0	
Pedestrian Calls (#/hr)		0			0			0			0	
Act Effct Green (s)	7.1	10.1		7.6	12.4		7.4	17.9		7.6	18.1	
Actuated g/C Ratio	0.13	0.20		0.14	0.25		0.14	0.36		0.14	0.37	
v/c Ratio	0.19	0.45		0.25	0.42		0.23	0.13		0.27	0.19	
Control Delay	26.5	16.0		24.3	17.1		25.1	12.1		24.9	15.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	26.5	16.0		24.3	17.1		25.1	12.1		24.9	15.1	
LOS	C	B		C	B		C	B		C	B	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		17.2			18.1			15.6			17.2	
Approach LOS		B			B			B			B	

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 49.4
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.45
Intersection Signal Delay: 17.2 — Intersection LOS: B
Intersection Capacity Utilization 36.1% — ICU Level of Service A
Analysis Period (min) 15

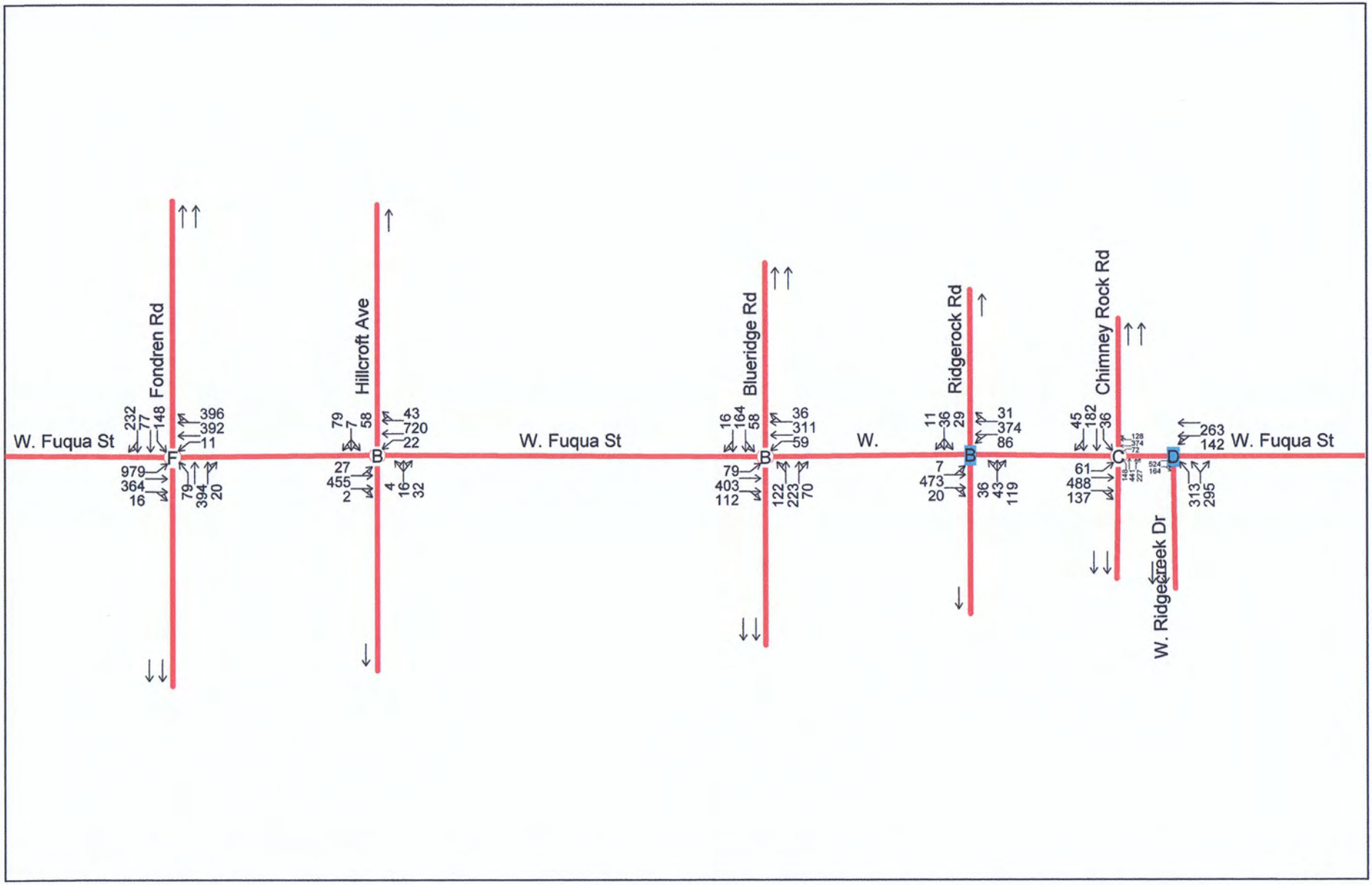
Splits and Phases: 14: W. Fuqua St & Chimney Rock Rd



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Stop			Stop	Stop	
Volume (vph)	255	213	204	312	135	73
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	277	232	222	339	147	79

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total (vph)	185	324	335	226	98	128
Volume Left (vph)	0	0	222	0	98	49
Volume Right (vph)	0	232	0	0	0	79
Hadj (s)	0.03	-0.47	0.37	0.03	0.53	-0.21
Departure Headway (s)	6.1	5.6	6.3	6.0	7.5	6.8
Degree Utilization, x	0.31	0.50	0.59	0.38	0.20	0.24
Capacity (veh/h)	567	627	558	585	448	495
Control Delay (s)	10.6	12.9	16.7	11.3	11.2	10.7
Approach Delay (s)	12.1		14.5		10.9	
Approach LOS	B		B		B	

Intersection Summary			
Delay	12.9		
HCM Level of Service	B		
Intersection Capacity Utilization	44.6%	ICU Level of Service	A
Analysis Period (min)	15		



W. Fuqa Street Network **02/17/13**

W. Fuqua Street Intersection Capacity Analysis **Scenario 2-AM 2035 Volumes, Lane Configuration and Intersection Level of Service**

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	200		0	200		0	200		0
Storage Lanes	1		0	1		0	1		0	1		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50		50	50	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.994			0.925			0.993			0.888	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3518	0	1770	3274	0	1770	3514	0	1770	3143	0
Flt Permitted	0.236			0.478			0.464			0.351		
Satd. Flow (perm)	440	3518	0	890	3274	0	864	3514	0	654	3143	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		6			67			5			252	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		1888			1696			1888			2112	
Travel Time (s)		36.8			33.0			28.6			32.0	
Volume (vph)	979	364	16	11	392	396	79	394	20	148	77	232
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1064	396	17	12	426	430	86	428	22	161	84	252
Lane Group Flow (vph)	1064	413	0	12	856	0	86	450	0	161	336	0
Turn Type	pm+pt			pm+pt			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases	4			8			2			6		
Detector Phases	7	4		3	8		2	2		6	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	8.0	20.0		8.0	20.0		20.0	20.0		20.0	20.0	
Total Split (s)	18.0	46.0	0.0	18.0	46.0	0.0	26.0	26.0	0.0	26.0	26.0	0.0
Total Split (%)	20.0%	51.1%	0.0%	20.0%	51.1%	0.0%	28.9%	28.9%	0.0%	28.9%	28.9%	0.0%
Maximum Green (s)	14.0	42.0		14.0	42.0		22.0	22.0		22.0	22.0	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		Max	Max		Max	Max	
Walk Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0		0	0		0	0	
Act Effct Green (s)	41.5	39.7		29.3	23.4		22.2	22.2		22.2	22.2	
Actuated g/C Ratio	0.58	0.55		0.37	0.33		0.31	0.31		0.31	0.31	
v/c Ratio	2.06	0.21		0.03	0.77		0.32	0.41		0.80	0.29	
Control Delay	502.3	8.7		8.5	21.0		25.6	22.0		56.1	6.9	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	502.3	8.7		8.5	21.0		25.6	22.0		56.1	6.9	
LOS	F	A		A	C		C	C		E	A	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		364.3			20.8			22.6			22.8	
Approach LOS		F			C			C			C	

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 71.7
Natural Cycle: 110
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 2.06
Intersection Signal Delay: 171.6 — Intersection LOS: F
Intersection Capacity Utilization 110.9% — ICU Level of Service H
Analysis Period (min) 15

Splits and Phases: 3: W. Fuqua St & Fondren Rd

ø2	ø3	ø4
26 s	18 s	46 s
ø6	ø7	ø8
26 s	18 s	46 s

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	100		0	0		0	0		0
Storage Lanes	0		0	1		0	0		0	0		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50		50	50	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.999			0.992			0.916			0.926	
Flt Protected		0.997		0.950				0.996			0.980	
Satd. Flow (prot)	0	3525	0	1770	3511	0	0	1699	0	0	1690	0
Flt Permitted		0.875		0.950				0.984			0.860	
Satd. Flow (perm)	0	3094	0	1770	3511	0	0	1679	0	0	1483	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					13			35			46	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		35			35			35			35	
Link Distance (ft)		1696			3216			1776			2064	
Travel Time (s)		33.0			62.6			34.6			40.2	
Volume (vph)	27	455	2	22	720	43	4	16	32	58	7	79
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	29	495	2	24	783	47	4	17	35	63	8	86
Lane Group Flow (vph)	0	526	0	24	830	0	0	56	0	0	157	0
Turn Type	Perm			Prot			Perm			Perm		
Protected Phases		4		3	8			2			6	
Permitted Phases	4						2			6		
Detector Phases	4	4		3	8		2	2		6	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	20.0	20.0		8.0	20.0		20.0	20.0		20.0	20.0	
Total Split (s)	70.0	70.0	0.0	20.0	90.0	0.0	30.0	30.0	0.0	30.0	30.0	0.0
Total Split (%)	58.3%	58.3%	0.0%	16.7%	75.0%	0.0%	25.0%	25.0%	0.0%	25.0%	25.0%	0.0%
Maximum Green (s)	66.0	66.0		16.0	86.0		26.0	26.0		26.0	26.0	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	
Lead/Lag	Lag	Lag		Lead								
Lead-Lag Optimize?	Yes	Yes		Yes								
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		Max	Max		Max	Max	
Walk Time (s)	5.0	5.0			5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)	11.0	11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0			0		0	0		0	0	
Act Effct Green (s)		16.6		6.4	20.5			26.6			26.6	
Actuated g/C Ratio		0.30		0.10	0.37			0.48			0.48	
v/c Ratio		0.57		0.13	0.63			0.07			0.21	
Control Delay		17.5		26.5	13.7			6.8			9.2	
Queue Delay		0.0		0.0	0.0			0.0			0.0	
Total Delay		17.5		26.5	13.7			6.8			9.2	
LOS		B		C	B			A			A	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		17.5			14.1			6.8			9.2	
Approach LOS		B			B			A			A	

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 55.3
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.63
Intersection Signal Delay: 14.5 — Intersection LOS: B
Intersection Capacity Utilization 54.6% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 5: W. Fuqua St & Hillcroft Ave

ø2	ø3	ø4
30 s	20 s	70 s
ø6	ø8	
30 s	90 s	

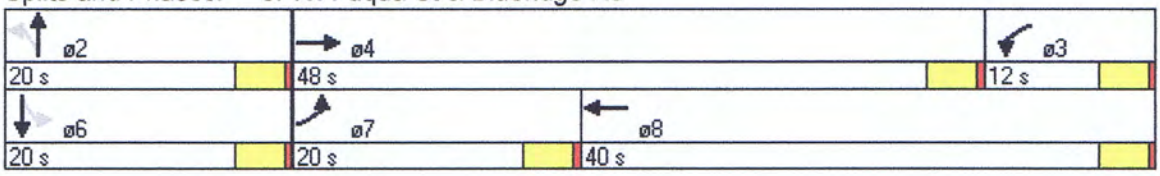
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		0	150		0	0		0	0		0
Storage Lanes	1		0	1		0	0		0	0		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50		50	50	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Frt		0.967			0.984			0.975			0.990	
Flt Protected	0.950			0.950				0.985			0.988	
Satd. Flow (prot)	1770	3422	0	1770	3483	0	0	3399	0	0	3462	0
Flt Permitted	0.950			0.950				0.751			0.672	
Satd. Flow (perm)	1770	3422	0	1770	3483	0	0	2592	0	0	2355	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		71			20			27			8	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		35			30			30			30	
Link Distance (ft)		3216			1696			1552			1600	
Travel Time (s)		62.6			38.5			35.3			36.4	
Volume (vph)	79	403	112	59	311	36	122	223	70	58	164	16
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	86	438	122	64	338	39	133	242	76	63	178	17
Lane Group Flow (vph)	86	560	0	64	377	0	0	451	0	0	258	0
Turn Type	Prot			Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		
Detector Phases	7	4		3	8		2	2		6	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	8.0	20.0		8.0	20.0		20.0	20.0		20.0	20.0	
Total Split (s)	20.0	48.0	0.0	12.0	40.0	0.0	20.0	20.0	0.0	20.0	20.0	0.0
Total Split (%)	25.0%	60.0%	0.0%	15.0%	50.0%	0.0%	25.0%	25.0%	0.0%	25.0%	25.0%	0.0%
Maximum Green (s)	16.0	44.0		8.0	36.0		16.0	16.0		16.0	16.0	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	
Lead/Lag	Lead	Lead		Lag	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		Max	Max		Max	Max	
Walk Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0		0	0		0	0	
Act Effct Green (s)	7.6	11.8		6.8	11.1			16.8			16.8	
Actuated g/C Ratio	0.16	0.27		0.14	0.26			0.39			0.39	
v/c Ratio	0.30	0.57		0.25	0.41			0.44			0.28	
Control Delay	19.1	12.6		21.2	13.8			13.4			12.7	
Queue Delay	0.0	0.0		0.0	0.0			0.0			0.0	
Total Delay	19.1	12.6		21.2	13.8			13.4			12.7	
LOS	B	B		C	B			B			B	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		13.5			14.9			13.4			12.7	
Approach LOS		B			B			B			B	

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 43
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.57
Intersection Signal Delay: 13.7 — Intersection LOS: B
Intersection Capacity Utilization 50.1% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 8: W. Fuqua St & Blueridge Rd



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	7	473	20	86	374	31	36	43	119	29	36	11
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	8	514	22	93	407	34	39	47	129	32	39	12

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total (vph)	265	279	297	237	215	83
Volume Left (vph)	8	0	93	0	39	32
Volume Right (vph)	0	22	0	34	129	12
Hadj (s)	0.05	-0.02	0.19	-0.07	-0.29	0.02
Departure Headway (s)	6.4	6.3	6.5	6.3	6.2	7.0
Degree Utilization, x	0.47	0.49	0.54	0.41	0.37	0.16
Capacity (veh/h)	541	552	534	555	527	453
Control Delay (s)	13.6	13.9	15.6	12.4	12.9	11.3
Approach Delay (s)	13.8		14.2		12.9	11.3
Approach LOS	B		B		B	B

Intersection Summary			
Delay	13.7		
HCM Level of Service	B		
Intersection Capacity Utilization	50.4%	ICU Level of Service	A
Analysis Period (min)	15		

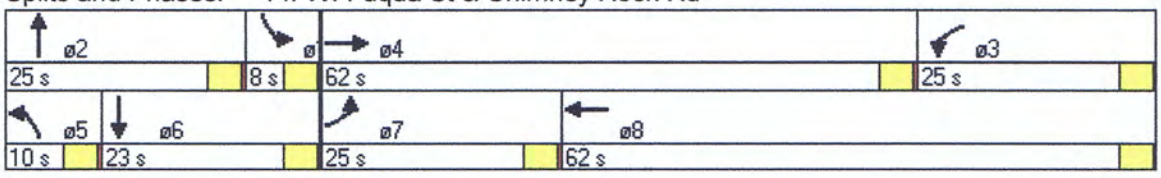
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		0	150		0	150		0	150		0
Storage Lanes	1		0	1		0	1		0	1		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50		50	50	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.967			0.962			0.949			0.970	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3422	0	1770	3405	0	1770	3359	0	1770	3433	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	3422	0	1770	3405	0	1770	3359	0	1770	3433	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		42			55			67			22	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1216			448			1008			1136	
Travel Time (s)		27.6			10.2			22.9			25.8	
Volume (vph)	61	488	137	72	374	128	148	441	227	36	182	45
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	66	530	149	78	407	139	161	479	247	39	198	49
Lane Group Flow (vph)	66	679	0	78	546	0	161	726	0	39	247	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Detector Phases	7	4		3	8		5	2		1	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	8.0	20.0		8.0	20.0		8.0	20.0		8.0	20.0	
Total Split (s)	25.0	62.0	0.0	25.0	62.0	0.0	10.0	25.0	0.0	8.0	23.0	0.0
Total Split (%)	20.8%	51.7%	0.0%	20.8%	51.7%	0.0%	8.3%	20.8%	0.0%	6.7%	19.2%	0.0%
Maximum Green (s)	21.0	58.0		21.0	58.0		6.0	21.0		4.0	19.0	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	
Lead/Lag	Lead	Lead		Lag	Lag		Lead	Lead		Lag	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		None	Max		None	Max	
Walk Time (s)		5.0			5.0			5.0			5.0	
Flash Dont Walk (s)		11.0			11.0			11.0			11.0	
Pedestrian Calls (#/hr)		0			0			0			0	
Act Effct Green (s)	7.9	17.3		8.3	17.6		6.3	26.1		4.1	19.9	
Actuated g/C Ratio	0.12	0.27		0.12	0.28		0.10	0.41		0.06	0.31	
v/c Ratio	0.32	0.70		0.36	0.55		0.91	0.51		0.36	0.23	
Control Delay	30.0	20.3		29.7	18.1		87.2	18.8		43.8	18.7	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	30.0	20.3		29.7	18.1		87.2	18.8		43.8	18.7	
LOS	C	C		C	B		F	B		D	B	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		21.1			19.5			31.3			22.1	
Approach LOS		C			B			C			C	

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 63.2
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.91
Intersection Signal Delay: 24.4 — Intersection LOS: C
Intersection Capacity Utilization 58.0% — ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 14: W. Fuqua St & Chimney Rock Rd



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Stop			Stop	Stop	
Volume (vph)	524	164	142	263	313	295
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	570	178	154	286	340	321

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total (vph)	380	368	250	191	227	434
Volume Left (vph)	0	0	154	0	227	113
Volume Right (vph)	0	178	0	0	0	321
Hadj (s)	0.03	-0.30	0.34	0.03	0.53	-0.35
Departure Headway (s)	7.6	7.3	8.4	8.0	8.2	7.3
Degree Utilization, x	0.80	0.74	0.58	0.43	0.52	0.88
Capacity (veh/h)	463	484	412	422	422	487
Control Delay (s)	33.8	27.2	21.1	15.7	18.4	42.0
Approach Delay (s)	30.6		18.7		33.9	
Approach LOS	D		C		D	

Intersection Summary			
Delay	28.9		
HCM Level of Service	D		
Intersection Capacity Utilization	59.4%	ICU Level of Service	B
Analysis Period (min)	15		

W. Fuqa Street Network **02/17/13**

W. Fuqua Street Intersection Capacity Analysis **Scenario 2-PM 2035 Volumes, Lane Configuration and Intersection Level of Service**

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	200		0	200		0	200		0
Storage Lanes	1		0	1		0	1		0	1		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50		50	50	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.993			0.971			0.993			0.881	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3514	0	1770	3437	0	1770	3514	0	1770	3118	0
Flt Permitted	0.196			0.396			0.154			0.154		
Satd. Flow (perm)	365	3514	0	738	3437	0	287	3514	0	287	3118	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		7			39			5			360	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		1888			1696			1888			2112	
Travel Time (s)		36.8			33.0			28.6			32.0	
Volume (vph)	441	470	23	20	706	169	142	709	36	331	218	842
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	479	511	25	22	767	184	154	771	39	360	237	915
Lane Group Flow (vph)	479	536	0	22	951	0	154	810	0	360	1152	0
Turn Type	pm+pt			pm+pt			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases	4			8			2			6		
Detector Phases	7	4		3	8		2	2		6	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	8.0	20.0		8.0	20.0		20.0	20.0		20.0	20.0	
Total Split (s)	19.0	51.0	0.0	19.0	51.0	0.0	30.0	30.0	0.0	30.0	30.0	0.0
Total Split (%)	19.0%	51.0%	0.0%	19.0%	51.0%	0.0%	30.0%	30.0%	0.0%	30.0%	30.0%	0.0%
Maximum Green (s)	15.0	47.0		15.0	47.0		26.0	26.0		26.0	26.0	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		Max	Max		Max	Max	
Walk Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0		0	0		0	0	
Act Effct Green (s)	46.8	43.0		33.8	27.7		26.2	26.2		26.2	26.2	
Actuated g/C Ratio	0.58	0.53		0.39	0.34		0.32	0.32		0.32	0.32	
v/c Ratio	1.01	0.29		0.06	0.79		1.66	0.71		3.87	1.21dr	
Control Delay	64.0	11.4		8.8	24.3		366.6	29.3		1338.4	32.5	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	64.0	11.4		8.8	24.3		366.6	29.3		1338.4	32.5	
LOS	E	B		A	C		F	C		F	C	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		36.2			23.9			83.2			343.5	
Approach LOS		D			C			F			F	

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 81
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 3.87
Intersection Signal Delay: 147.8 Intersection LOS: F
Intersection Capacity Utilization 103.8% ICU Level of Service G
Analysis Period (min) 15
dr Defacto Right Lane. Recode with 1 though lane as a right lane.

Splits and Phases: 3: W. Fuqua St & Fondren Rd

ø2	ø3	ø4
30 s	19 s	51 s
ø6	ø7	ø8
30 s	19 s	51 s

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	100		0	0		0	0		0
Storage Lanes	0		0	1		0	0		0	0		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50		50	50	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.998			0.991			0.888			0.943	
Flt Protected		0.999		0.950				0.998			0.977	
Satd. Flow (prot)	0	3529	0	1770	3507	0	0	1651	0	0	1716	0
Flt Permitted		0.921		0.950				0.988			0.832	
Satd. Flow (perm)	0	3253	0	1770	3507	0	0	1634	0	0	1461	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			11			34			40	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		35			35			35			35	
Link Distance (ft)		1696			3216			1776			2064	
Travel Time (s)		33.0			62.6			34.6			40.2	
Volume (vph)	23	734	9	27	571	36	2	5	31	159	40	144
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	25	798	10	29	621	39	2	5	34	173	43	157
Lane Group Flow (vph)	0	833	0	29	660	0	0	41	0	0	373	0
Turn Type	Perm			Prot			Perm			Perm		
Protected Phases		4		3	8			2			6	
Permitted Phases	4						2			6		
Detector Phases	4	4		3	8		2	2		6	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	20.0	20.0		8.0	20.0		20.0	20.0		20.0	20.0	
Total Split (s)	42.0	42.0	0.0	20.0	62.0	0.0	38.0	38.0	0.0	38.0	38.0	0.0
Total Split (%)	42.0%	42.0%	0.0%	20.0%	62.0%	0.0%	38.0%	38.0%	0.0%	38.0%	38.0%	0.0%
Maximum Green (s)	38.0	38.0		16.0	58.0		34.0	34.0		34.0	34.0	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	
Lead/Lag	Lag	Lag		Lead								
Lead-Lag Optimize?	Yes	Yes		Yes								
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		Max	Max		Max	Max	
Walk Time (s)	5.0	5.0			5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)	11.0	11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0			0		0	0		0	0	
Act Effct Green (s)		23.7		6.8	27.7			35.2			35.2	
Actuated g/C Ratio		0.33		0.09	0.39			0.49			0.49	
v/c Ratio		0.77		0.19	0.48			0.05			0.50	
Control Delay		23.0		36.4	15.3			7.6			17.4	
Queue Delay		0.0		0.0	0.0			0.0			0.0	
Total Delay		23.0		36.4	15.3			7.6			17.4	
LOS		C		D	B			A			B	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		23.0			16.2			7.6			17.4	
Approach LOS		C			B			A			B	

Intersection Summary

Area Type: Other
Cycle Length: 100
Actuated Cycle Length: 71.2
Natural Cycle: 55
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.77
Intersection Signal Delay: 19.2 — Intersection LOS: B
Intersection Capacity Utilization 70.3% — ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 5: W. Fuqua St & Hillcroft Ave

ø2	ø3	ø4
38 s	20 s	42 s

ø6	ø8
38 s	62 s

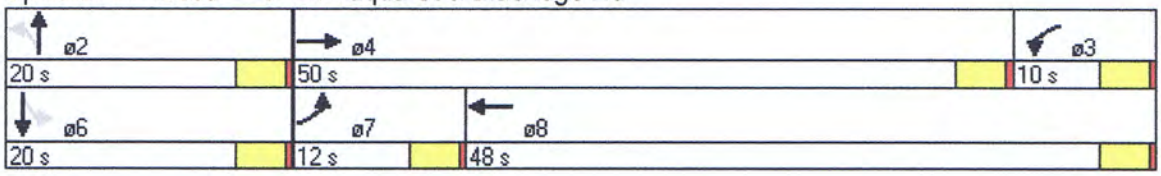
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		0	150		0	0		0	0		0
Storage Lanes	1		0	1		0	0		0	0		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50		50	50	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Frt		0.972			0.992			0.979			0.963	
Flt Protected	0.950			0.950				0.982			0.990	
Satd. Flow (prot)	1770	3440	0	1770	3511	0	0	3403	0	0	3374	0
Flt Permitted	0.950			0.950				0.702			0.841	
Satd. Flow (perm)	1770	3440	0	1770	3511	0	0	2432	0	0	2866	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		59			11			20			51	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		35			30			30			30	
Link Distance (ft)		3216			1696			1552			1600	
Travel Time (s)		62.6			38.5			35.3			36.4	
Volume (vph)	83	463	108	83	410	23	77	106	29	54	148	67
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	90	503	117	90	446	25	84	115	32	59	161	73
Lane Group Flow (vph)	90	620	0	90	471	0	0	231	0	0	293	0
Turn Type	Prot			Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		
Detector Phases	7	4		3	8		2	2		6	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	8.0	20.0		8.0	20.0		20.0	20.0		20.0	20.0	
Total Split (s)	12.0	50.0	0.0	10.0	48.0	0.0	20.0	20.0	0.0	20.0	20.0	0.0
Total Split (%)	15.0%	62.5%	0.0%	12.5%	60.0%	0.0%	25.0%	25.0%	0.0%	25.0%	25.0%	0.0%
Maximum Green (s)	8.0	46.0		6.0	44.0		16.0	16.0		16.0	16.0	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	
Lead/Lag	Lead	Lead		Lag	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		Max	Max		Max	Max	
Walk Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0		0	0		0	0	
Act Effct Green (s)	7.2	13.0		6.1	14.0			16.5			16.5	
Actuated g/C Ratio	0.15	0.29		0.13	0.31			0.36			0.36	
v/c Ratio	0.35	0.60		0.40	0.43			0.26			0.27	
Control Delay	22.9	13.2		26.2	13.5			12.3			11.1	
Queue Delay	0.0	0.0		0.0	0.0			0.0			0.0	
Total Delay	22.9	13.2		26.2	13.5			12.3			11.1	
LOS	C	B		C	B			B			B	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		14.4			15.6			12.3			11.1	
Approach LOS		B			B			B			B	

Intersection Summary

Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 45.3
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.60
Intersection Signal Delay: 13.9 — Intersection LOS: B
Intersection Capacity Utilization 48.1% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 8: W. Fuqua St & Blueridge Rd



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	34	504	32	131	475	50	22	18	34	38	13	29
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	37	548	35	142	516	54	24	20	37	41	14	32

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1
Volume Total (vph)	311	309	401	313	80	87
Volume Left (vph)	37	0	142	0	24	41
Volume Right (vph)	0	35	0	54	37	32
Hadj (s)	0.09	-0.04	0.21	-0.09	-0.18	-0.09
Departure Headway (s)	6.1	6.0	6.1	5.8	6.6	6.7
Degree Utilization, x	0.53	0.51	0.68	0.50	0.15	0.16
Capacity (veh/h)	570	589	579	606	486	490
Control Delay (s)	14.5	13.8	19.9	13.4	10.8	11.0
Approach Delay (s)	14.2		17.0		10.8	11.0
Approach LOS	B		C		B	B

Intersection Summary			
Delay	15.2		
HCM Level of Service	C		
Intersection Capacity Utilization	51.9%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	150		0	150		0	150		0	150		0
Storage Lanes	1		0	1		0	1		0	1		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50		50	50	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.957			0.986			0.945			0.970	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	3387	0	1770	3490	0	1770	3345	0	1770	3433	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	3387	0	1770	3490	0	1770	3345	0	1770	3433	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		75			14			78			21	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		1216			448			1008			1136	
Travel Time (s)		27.6			10.2			22.9			25.8	
Volume (vph)	72	401	164	103	673	68	94	166	95	113	326	81
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	78	436	178	112	732	74	102	180	103	123	354	88
Lane Group Flow (vph)	78	614	0	112	806	0	102	283	0	123	442	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Detector Phases	7	4		3	8		5	2		1	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	8.0	20.0		8.0	20.0		8.0	20.0		8.0	20.0	
Total Split (s)	14.0	65.0	0.0	20.0	71.0	0.0	15.0	20.0	0.0	15.0	20.0	0.0
Total Split (%)	11.7%	54.2%	0.0%	16.7%	59.2%	0.0%	12.5%	16.7%	0.0%	12.5%	16.7%	0.0%
Maximum Green (s)	10.0	61.0		16.0	67.0		11.0	16.0		11.0	16.0	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	
Lead/Lag	Lead	Lead		Lag	Lag		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		None	Max		None	Max	
Walk Time (s)		5.0			5.0			5.0			5.0	
Flash Dont Walk (s)		11.0			11.0			11.0			11.0	
Pedestrian Calls (#/hr)		0			0			0			0	
Act Effct Green (s)	8.3	17.4		12.4	21.4		9.0	17.9		9.7	18.4	
Actuated g/C Ratio	0.12	0.26		0.18	0.32		0.13	0.26		0.14	0.27	
v/c Ratio	0.37	0.66		0.36	0.73		0.44	0.30		0.50	0.47	
Control Delay	35.9	22.0		29.7	21.7		35.9	20.1		37.1	26.7	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	35.9	22.0		29.7	21.7		35.9	20.1		37.1	26.7	
LOS	D	C		C	C		D	C		D	C	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		23.6			22.7			24.3			29.0	
Approach LOS		C			C			C			C	

Intersection Summary

Area Type: Other
Cycle Length: 120
Actuated Cycle Length: 67.8
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.73
Intersection Signal Delay: 24.5 — Intersection LOS: C
Intersection Capacity Utilization 54.9% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 14: W. Fuqua St & Chimney Rock Rd

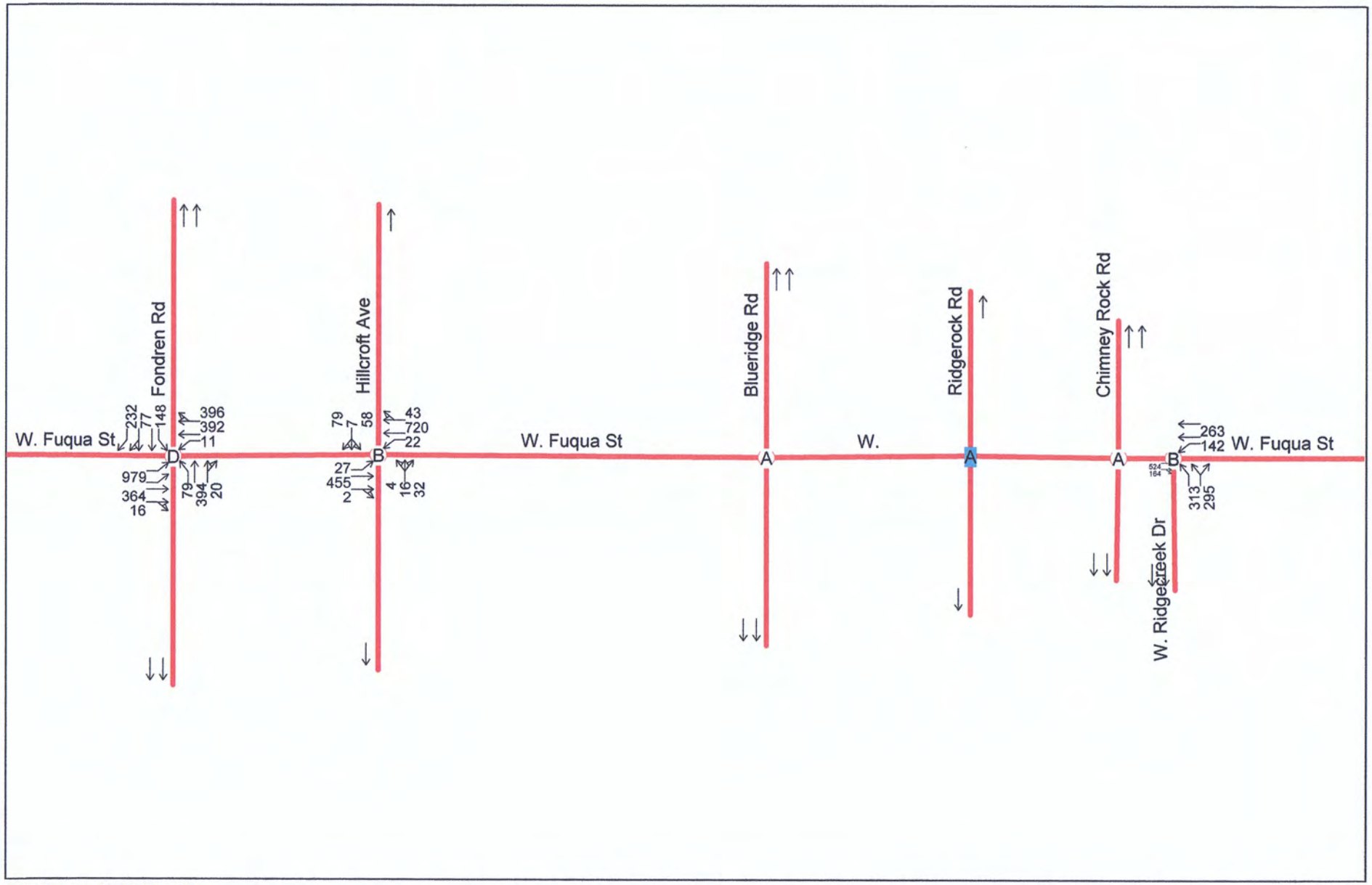
ø1	ø2	ø4	ø3
15 s	20 s	65 s	20 s

ø5	ø6	ø7	ø8
15 s	20 s	14 s	71 s

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Stop			Stop	Stop	
Volume (vph)	459	383	367	562	243	131
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	499	416	399	611	264	142

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total (vph)	333	583	603	407	176	230
Volume Left (vph)	0	0	399	0	176	88
Volume Right (vph)	0	416	0	0	0	142
Hadj (s)	0.03	-0.47	0.37	0.03	0.53	-0.21
Departure Headway (s)	7.5	7.0	7.8	7.4	8.9	8.2
Degree Utilization, x	0.69	1.14	1.30	0.84	0.44	0.52
Capacity (veh/h)	471	515	473	479	385	420
Control Delay (s)	24.7	106.9	171.4	37.2	17.5	18.7
Approach Delay (s)	77.0		117.3		18.2	
Approach LOS	F		F		C	

Intersection Summary			
Delay	84.2		
HCM Level of Service	F		
Intersection Capacity Utilization	72.2%	ICU Level of Service	C
Analysis Period (min)	15		



W. Fuqua St Network

W. Fuqua Street Intersection Capacity Analysis

02/19/13

Scenario 3-AM 2035 Analysis with Mitigation Measures, LOS, Volumes & Lane Configuration

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	300		0	200		0	200		0	200		200
Storage Lanes	2		0	1		0	1		0	1		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50		50	50	50
Trailing Detector (ft)	0	0		0	0		0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.97	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.91	0.91
Frt		0.994			0.925			0.993			0.910	0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3433	3518	0	1770	3274	0	1770	3514	0	1770	3085	1441
Flt Permitted	0.950			0.950			0.579			0.288		
Satd. Flow (perm)	3433	3518	0	1770	3274	0	1079	3514	0	536	3085	1441
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		5			130			5			126	126
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		1888			1696			1888			2112	
Travel Time (s)		36.8			33.0			28.6			32.0	
Volume (vph)	979	364	16	11	392	396	79	394	20	148	77	232
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1064	396	17	12	426	430	86	428	22	161	84	252
Lane Group Flow (vph)	1064	413	0	12	856	0	86	450	0	161	210	126
Turn Type	Split			Split			pm+pt			pm+pt		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases							2			6		6
Detector Phases	4	4		8	8		5	2		1	6	6
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Minimum Split (s)	20.0	20.0		20.0	20.0		8.0	20.0		8.0	20.0	20.0
Total Split (s)	34.0	34.0	0.0	26.0	26.0	0.0	9.0	21.0	0.0	9.0	21.0	21.0
Total Split (%)	37.8%	37.8%	0.0%	28.9%	28.9%	0.0%	10.0%	23.3%	0.0%	10.0%	23.3%	23.3%
Maximum Green (s)	30.0	30.0		22.0	22.0		5.0	17.0		5.0	17.0	17.0
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	3.5
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	0.5
Lead/Lag							Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None		None	None		None	C-Max		None	C-Max	C-Max
Walk Time (s)	5.0	5.0		5.0	5.0			5.0			5.0	5.0
Flash Dont Walk (s)	11.0	11.0		11.0	11.0			11.0			11.0	11.0
Pedestrian Calls (#/hr)	0	0		0	0			0			0	0
Act Effct Green (s)	30.0	30.0		22.0	22.0		22.0	17.0		22.8	18.8	18.8
Actuated g/C Ratio	0.33	0.33		0.24	0.24		0.24	0.19		0.25	0.21	0.21
v/c Ratio	0.93	0.35		0.03	0.95		0.28	0.67		0.79	0.28	0.31
Control Delay	44.3	23.4		26.3	50.0		27.1	39.3		55.3	14.4	8.4
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	44.3	23.4		26.3	50.0		27.1	39.3		55.3	14.4	8.4
LOS	D	C		C	D		C	D		E	B	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		38.5			49.7			37.3			26.1	
Approach LOS		D			D			D			C	

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.95
Intersection Signal Delay: 39.4 — Intersection LOS: D
Intersection Capacity Utilization 84.5% — ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 3: W. Fuqua St & Fondren Rd

ø1	ø2	ø4	ø8
9 s	21 s	34 s	26 s
ø5	ø6		
9 s	21 s		

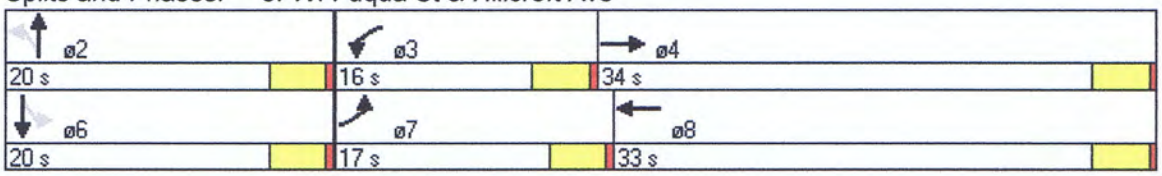
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	100		0	0		0	0		0
Storage Lanes	1		0	1		0	0		0	0		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50		50	50	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	0.95	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.999			0.992			0.916			0.926	
Flt Protected	0.950			0.950				0.996			0.980	
Satd. Flow (prot)	1770	3536	0	1770	3511	0	0	1699	0	0	1690	0
Flt Permitted	0.950			0.950				0.983			0.864	
Satd. Flow (perm)	1770	3536	0	1770	3511	0	0	1677	0	0	1490	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			11			35			81	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		35			35			35			35	
Link Distance (ft)		1696			3216			1776			2064	
Travel Time (s)		33.0			62.6			34.6			40.2	
Volume (vph)	27	455	2	22	720	43	4	16	32	58	7	79
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	29	495	2	24	783	47	4	17	35	63	8	86
Lane Group Flow (vph)	29	497	0	24	830	0	0	56	0	0	157	0
Turn Type	Prot			Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		
Detector Phases	7	4		3	8		2	2		6	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	8.0	20.0		8.0	20.0		20.0	20.0		20.0	20.0	
Total Split (s)	17.0	34.0	0.0	16.0	33.0	0.0	20.0	20.0	0.0	20.0	20.0	0.0
Total Split (%)	24.3%	48.6%	0.0%	22.9%	47.1%	0.0%	28.6%	28.6%	0.0%	28.6%	28.6%	0.0%
Maximum Green (s)	13.0	30.0		12.0	29.0		16.0	16.0		16.0	16.0	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		C-Max	C-Max		C-Max	C-Max	
Walk Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0		0	0		0	0	
Act Effct Green (s)	6.5	23.8		6.2	21.5			35.8			35.8	
Actuated g/C Ratio	0.09	0.34		0.09	0.31			0.51			0.51	
v/c Ratio	0.18	0.41		0.15	0.76			0.06			0.20	
Control Delay	29.4	17.5		29.7	22.7			8.3			8.4	
Queue Delay	0.0	0.0		0.0	0.0			0.0			0.0	
Total Delay	29.4	17.5		29.7	22.7			8.3			8.4	
LOS	C	B		C	C			A			A	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		18.1			22.9			8.3			8.4	
Approach LOS		B			C			A			A	

Intersection Summary

Area Type: Other
Cycle Length: 70
Actuated Cycle Length: 70
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 50
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.76
Intersection Signal Delay: 19.4 Intersection LOS: B
Intersection Capacity Utilization 44.2% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 5: W. Fuqua St & Hillcroft Ave

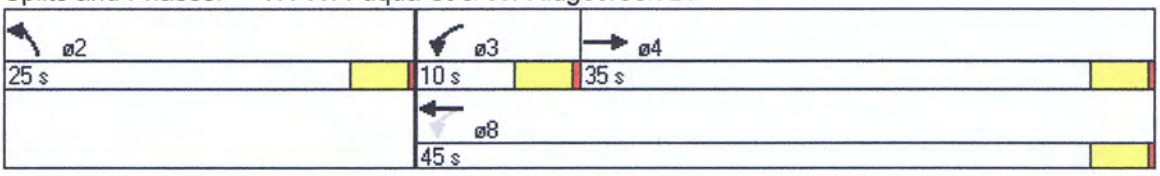


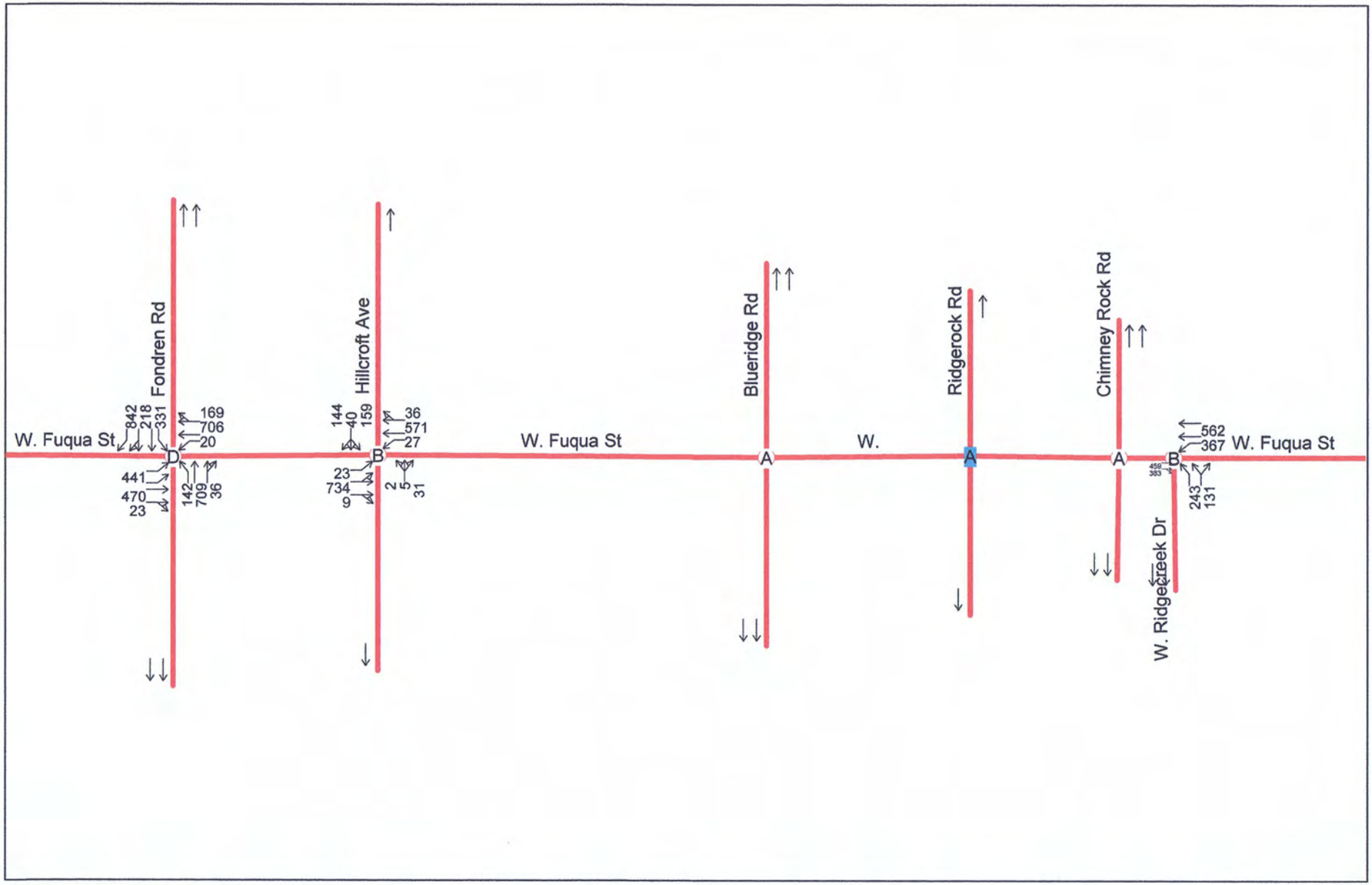
Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50		50	50	50	
Trailing Detector (ft)	0		0	0	0	
Turning Speed (mph)		9	15		15	9
Lane Util. Factor	0.95	0.95	1.00	0.95	0.97	0.95
Frt	0.964				0.927	
Flt Protected			0.950		0.975	
Satd. Flow (prot)	3412	0	1770	3539	3266	0
Flt Permitted			0.253		0.975	
Satd. Flow (perm)	3412	0	471	3539	3266	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	76				321	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)	30			30	30	
Link Distance (ft)	448			2336	1088	
Travel Time (s)	10.2			53.1	24.7	
Volume (vph)	524	164	142	263	313	295
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	570	178	154	286	340	321
Lane Group Flow (vph)	748	0	154	286	661	0
Turn Type			pm+pt			
Protected Phases	4		3	8	2	
Permitted Phases			8			
Detector Phases	4		3	8	2	
Minimum Initial (s)	4.0		4.0	4.0	4.0	
Minimum Split (s)	20.0		8.0	20.0	20.0	
Total Split (s)	35.0	0.0	10.0	45.0	25.0	0.0
Total Split (%)	50.0%	0.0%	14.3%	64.3%	35.7%	0.0%
Maximum Green (s)	31.0		6.0	41.0	21.0	
Yellow Time (s)	3.5		3.5	3.5	3.5	
All-Red Time (s)	0.5		0.5	0.5	0.5	
Lead/Lag	Lag		Lead			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Recall Mode	None		None	None	C-Min	
Walk Time (s)	5.0			5.0	5.0	
Flash Dont Walk (s)	11.0			11.0	11.0	
Pedestrian Calls (#/hr)	0			0	0	
Act Effct Green (s)	18.9		31.1	31.1	30.9	
Actuated g/C Ratio	0.27		0.44	0.44	0.44	
v/c Ratio	0.76		0.43	0.18	0.41	
Control Delay	21.5		14.4	11.1	8.2	
Queue Delay	0.0		0.0	0.0	0.0	
Total Delay	21.5		14.4	11.1	8.2	
LOS	C		B	B	A	
Approach Delay	21.5			12.3	8.2	
Approach LOS	C			B	A	

Intersection Summary

Area Type: Other
Cycle Length: 70
Actuated Cycle Length: 70
Offset: 0 (0%), Referenced to phase 2:NBL and 6:, Start of Green
Natural Cycle: 50
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.76
Intersection Signal Delay: 14.5 Intersection LOS: B
Intersection Capacity Utilization 55.8% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 17: W. Fuqua St & W. Ridgecreek Dr





W. Fuqua St Network

W. Fuqua Street Intersection Capacity Analysis

02/19/13

Scenario 3-PM 2035 Analysis with Mitigation Measures, LOS, Volumes & Lane Configuration

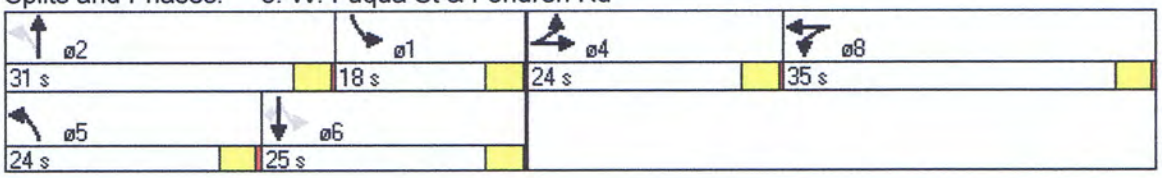
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	200		0	200		0	200		0
Storage Lanes	2		0	1		0	1		0	1		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50		50	50	50
Trailing Detector (ft)	0	0		0	0		0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.97	0.95	0.95	1.00	0.95	0.95	1.00	0.95	0.95	1.00	0.91	0.91
Frt		0.993			0.971			0.993			0.901	0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3433	3514	0	1770	3437	0	1770	3514	0	1770	3055	1441
Flt Permitted	0.950			0.950			0.571			0.571		
Satd. Flow (perm)	3433	3514	0	1770	3437	0	1064	3514	0	1064	3055	1441
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		4			27			4			402	447
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		1888			1696			1888			2112	
Travel Time (s)		36.8			33.0			28.6			32.0	
Volume (vph)	441	470	23	20	706	169	142	709	36	331	218	842
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	479	511	25	22	767	184	154	771	39	360	237	915
Lane Group Flow (vph)	479	536	0	22	951	0	154	810	0	360	694	458
Turn Type	Split			Split			pm+pt			pm+pt		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases							2			6		6
Detector Phases	4	4		8	8		5	2		1	6	6
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	4.0
Minimum Split (s)	20.0	20.0		20.0	20.0		8.0	20.0		8.0	20.0	20.0
Total Split (s)	24.0	24.0	0.0	35.0	35.0	0.0	24.0	31.0	0.0	18.0	25.0	25.0
Total Split (%)	22.2%	22.2%	0.0%	32.4%	32.4%	0.0%	22.2%	28.7%	0.0%	16.7%	23.1%	23.1%
Maximum Green (s)	20.0	20.0		31.0	31.0		20.0	27.0		14.0	21.0	21.0
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	3.5
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	0.5
Lead/Lag							Lead	Lead		Lag	Lag	Lag
Lead-Lag Optimize?							Yes	Yes		Yes	Yes	Yes
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None		None	None		None	C-Max		None	C-Max	C-Max
Walk Time (s)	5.0	5.0		5.0	5.0			5.0			5.0	5.0
Flash Dont Walk (s)	11.0	11.0		11.0	11.0			11.0			11.0	11.0
Pedestrian Calls (#/hr)	0	0		0	0			0			0	0
Act Effct Green (s)	19.5	19.5		30.8	30.8		27.8	27.8		28.5	28.5	28.5
Actuated g/C Ratio	0.18	0.18		0.29	0.29		0.26	0.26		0.26	0.26	0.26
v/c Ratio	0.77	0.84		0.04	0.95		0.43	0.89		0.97	0.63	0.65
Control Delay	50.5	53.8		28.2	55.3		36.3	52.4		82.1	17.8	8.8
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	50.5	53.8		28.2	55.3		36.3	52.4		82.1	17.8	8.8
LOS	D	D		C	E		D	D		F	B	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		52.2			54.7			49.9			30.4	
Approach LOS		D			D			D			C	

Intersection Summary

Area Type: Other
Cycle Length: 108
Actuated Cycle Length: 108
Offset: 88 (81%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Natural Cycle: 90
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.97
Intersection Signal Delay: 44.8 Intersection LOS: D
Intersection Capacity Utilization 89.9% ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 3: W. Fuqua St & Fondren Rd



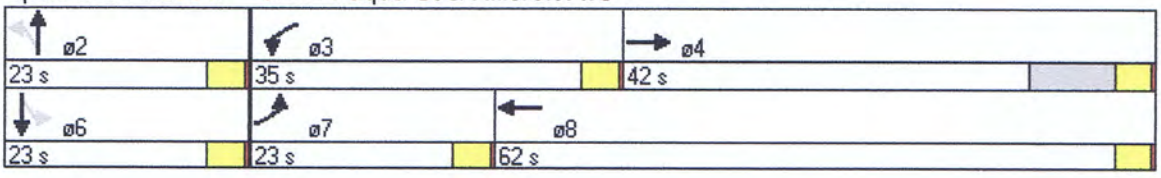
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	100		0	0		0	0		0
Storage Lanes	1		0	1		0	0		0	0		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50		50	50	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.91	0.91	0.95	1.00	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.998			0.991			0.888			0.943	
Flt Protected	0.950			0.950				0.998			0.977	
Satd. Flow (prot)	1610	3383	0	1770	3507	0	0	1651	0	0	1716	0
Flt Permitted	0.950			0.950				0.986			0.854	
Satd. Flow (perm)	1610	3383	0	1770	3507	0	0	1631	0	0	1500	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			9			34			29	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		35			35			35			35	
Link Distance (ft)		1696			3216			1776			2064	
Travel Time (s)		33.0			62.6			34.6			40.2	
Volume (vph)	23	734	9	27	571	36	2	5	31	159	40	144
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	25	798	10	29	621	39	2	5	34	173	43	157
Lane Group Flow (vph)	25	808	0	29	660	0	0	41	0	0	373	0
Turn Type	Prot			Prot			Perm			Perm		
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2			6		
Detector Phases	7	4		3	8		2	2		6	6	
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	8.0	20.0		8.0	20.0		20.0	20.0		20.0	20.0	
Total Split (s)	23.0	42.0	0.0	35.0	62.0	0.0	23.0	23.0	0.0	23.0	23.0	0.0
Total Split (%)	21.3%	38.9%	0.0%	32.4%	57.4%	0.0%	21.3%	21.3%	0.0%	21.3%	21.3%	0.0%
Maximum Green (s)	19.0	38.0		31.0	58.0		19.0	19.0		19.0	19.0	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		Max	Max		Max	Max	
Walk Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)		11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)		0			0		0	0		0	0	
Act Effct Green (s)	6.5	17.6		6.5	19.4			20.1			20.1	
Actuated g/C Ratio	0.11	0.35		0.12	0.39			0.40			0.40	
v/c Ratio	0.14	0.68		0.14	0.48			0.06			0.60	
Control Delay	27.0	14.5		25.1	11.4			8.2			21.1	
Queue Delay	0.0	0.0		0.0	0.0			0.0			0.0	
Total Delay	27.0	14.5		25.1	11.4			8.2			21.1	
LOS	C	B		C	B			A			C	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		14.9			11.9			8.2			21.1	
Approach LOS		B			B			A			C	

Intersection Summary

Area Type: Other
Cycle Length: 108
Actuated Cycle Length: 49.8
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.68
Intersection Signal Delay: 14.9 — Intersection LOS: B
Intersection Capacity Utilization 57.9% — ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 5: W. Fuqua St & Hillcroft Ave



Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50		50	50	50	
Trailing Detector (ft)	0		0	0	0	
Turning Speed (mph)		9	15		15	9
Lane Util. Factor	0.95	0.95	1.00	0.95	0.97	0.95
Frt	0.932				0.948	
Flt Protected			0.950		0.969	
Satd. Flow (prot)	3299	0	1770	3539	3320	0
Flt Permitted			0.154		0.969	
Satd. Flow (perm)	3299	0	287	3539	3320	0
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	315				142	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)	30			30	30	
Link Distance (ft)	448			2336	1088	
Travel Time (s)	10.2			53.1	24.7	
Volume (vph)	459	383	367	562	243	131
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	499	416	399	611	264	142
Lane Group Flow (vph)	915	0	399	611	406	0
Turn Type			pm+pt			
Protected Phases	4		3	8	2	
Permitted Phases			8			
Detector Phases	4		3	8	2	
Minimum Initial (s)	4.0		4.0	4.0	4.0	
Minimum Split (s)	20.0		8.0	20.0	20.0	
Total Split (s)	26.0	0.0	23.0	49.0	21.0	0.0
Total Split (%)	37.1%	0.0%	32.9%	70.0%	30.0%	0.0%
Maximum Green (s)	22.0		19.0	45.0	17.0	
Yellow Time (s)	3.5		3.5	3.5	3.5	
All-Red Time (s)	0.5		0.5	0.5	0.5	
Lead/Lag	Lag		Lead			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Recall Mode	None		None	None	C-Min	
Walk Time (s)	5.0			5.0	5.0	
Flash Dont Walk (s)	11.0			11.0	11.0	
Pedestrian Calls (#/hr)	0			0	0	
Act Effct Green (s)	19.3		39.8	39.8	22.2	
Actuated g/C Ratio	0.28		0.57	0.57	0.32	
v/c Ratio	0.80		0.78	0.30	0.35	
Control Delay	18.3		20.2	7.6	14.6	
Queue Delay	0.0		0.0	0.0	0.0	
Total Delay	18.3		20.2	7.6	14.6	
LOS	B		C	A	B	
Approach Delay	18.3			12.5	14.6	
Approach LOS	B			B	B	

APPENDIX H

CONSTRUCTION COST ESTIMATES

Pre-Engineering Services Contracts

Project Cost Estimate Breakdown (FY13 Dollars)

W. Fuqua Need Area NT R1-Alternative D

1	**410 (Summarized based on FY 13 List of Unit Prices)**		$13,601,913.72
	1.1	Total Unit Price, General Items (10% of 410)	$1,236,537.61
	1.2	Total Unit Price, Paving Items	$4,062,510.61
	1.3	Total Unit Price, Storm Sewer Items	$2,288,225.50
	1.4	Total Unit Price, Water Items	$6,001,080.00
	1.5	Total Unit Price, Wastewater Items	$13,560.00
	1.6	Wastewater Substitute Services [1]	
2	**Contingency (30% of 410)**		**$4,080,574.12**
3	**Construction Management (15% of 410)**		**$2,040,287.06**
4	**Engineering Fee Estimate (10% of Sum of 410 and Contingency)**		**$1,768,248.78**
5	**Design Management (15% of Engineering Fee Estimate)**		**$265,237.32**
6	**Land Acquisition (Engineer's Best Estimate)**		
	Total Project Cost		**$21,756,261.00**

Note 1: Wastewater Items separated for CIP Programming purpose.

Pre-Engineering Services Contracts

COH Rebuild Funds to Calculate Candidate Project Priority Score

W. Fuqua Need Area NT R1-Alternative D

1	**410 (Summarized based on FY 13 List of Unit Prices)**		$6,985,809.71
	1.1	Total Unit Price, General Items (10% of 410)	$635,073.61
	1.2	Total Unit Price, Paving Items	$4,062,510.60
	1.3	Total Unit Price, Storm Sewer Items	$2,288,225.50
2	**Contingency (30% of 410)**		**$2,095,742.91**
3	**Construction Management (15% of 410)**		**$1,047,871.46**
4	**Engineering Fee Estimate (10% of Sum of 410 and Contingency)**		**$908,155.26**
5	**Design Management (15% of Engineering Fee Estimate)**		**$136,223.29**
6	**Land Acquisition (Engineer's Best Estimate)**		
	Total Project Cost		**$11,173,802.63**

Major Thoroughfare and Collectors Candidate Project Priority Score Determination Alternative D

W. Fuqua Street-Chimney Rock to Missouri City Limit (4 lane with median for entire project length)

Infratructure Category	Weight	Criteria	Project Parameter	Point Range	Measurement or Calculation	Points
Streets	75%	Pavement Condition 60%	Avg. PCR=62.92	0-60	0.6x(100-PCR)	22.25
		Ttraffic level of Service 15%	Existing LOS: A-C;Proposed LOS:B-D	0-15	F to C or Better=15; E to C or Better=10; D to C or better=5	0
Drainage System	15%	Extreme Event Level of Service	Improve to convey extreme event	0-5	No improvements=0; Partial improvements=3; Conveys extreme event=5	5
		Design Level of Service	Improve to convey design event	0-10	No improvements=0; Partial improvements=5; Conveys extreme event=10	10
Water	5%	WIRP Rank (1045 total area)	40.8	0-5	Replace since 2000=0; ((Total WIRP Areas-WIRP Rank)/Total WIRP Areas)x5	3.04
Wastewater	5%	SSO	SSO	0-2	No SSO=0; SSO=1; Repeat SSO=2	0
		MLR	Avg.Rating=5	0-2	MLR<4=0; MLR 4-13=1; MLR> 13=2	1
		Age of Pipe	30+Years	0-1	30years or less=0; More than 30 years=1; Agreed Order=1	1
					Service Area Benefit Factor	42.29

Candidate Project Priority Score = Service Benefit Factor x $\frac{\text{Benifeted Pobulation}}{\text{City Rebuild Houston Funds}}$

$$42.29 \times \frac{12924.00}{11173.80}$$

Candidate Project Priority Score =	48.91

FY 2013 Candidate Projects ($ Thousands)
Street & Traffic Control Program - Thoroughfares

Candidate Project Summary Information

Need Area:	*NT R1*	**Alternative No.:**	**D**
Name:	*W. FUQUA*	**Council District:**	**K**
Limits:	*CHIMNEY ROCK TO MISSOURI CITY LIMIT*	**Key Map No.:**	**570Z, 571W**
Type:	Major Thoroughfare and Collector	**Super Neighborhood:**	**FORT BEND/HOUSTON**
WBS No.:	N-0001000-0005-3	**Total No. of Sub-projects:**	**0**
Description:	*Project provides for the ROW acquisition, design and construction of a X-Lane Divided/Non-Divided concrete with curbs, sidewalks, driveways, street lighting, traffic control and necessary underground utilities. Project includes crossings over .....*		
Justification:	*Project will replace (and widen) a street that has been deteriorated beyond economical repair and normal maintenance. It will improve traffic circulation, mobility and drainage in service area. These improvements will upgrade existing roadway to MTFP standards, if applicable.*		

Implementation - Estimated Cost and Duration

	City Funds	Other Entities Funds	Total	Duration
Total Project Cost	$ 21,756	$ -	$ -	
Acquisition		$ -	$ -	_____Months
Design	$ 2,033	$ -	$ -	12
Construction	$ 15,642	$ -	$ -	12
Contingency	$ 4,081	$ -	$ -	NA
Private Utility Reloc.	$ -	$ -	$ -	_____Months
Warranty	$ -	$ -	$ -	12 Months

Candidate Project Priority Scores

Infrastructure Categories	Benefit Scores (Total Maximum 100)	
	Maximum	**Actual**
Streets	**75**	**22.25**
Drainage System	**15**	**15.00**
Water	**5**	**3.04**
Wastewater	**5**	**2.00**
Total	**100**	**42.29**
	Service Area Benefit score:	42.29
	Benefitted Population:	12924
	Rebuild Houston Funds:	$ 11,174
	Candidate Project Priority Score:	**48.91**
	Candidate Project Priority Rank No.:	(To be assigned by the City)

Other Entities & Jurisdictions Coordination

Entities		Coordination For
TxDOT	☐	
Metro	X	
HCFCD	X	
Gulf Cost Railroad District	☐	
Union Pacific Rail Road	☐	
Harris County	☐	
Fort Bend County	X	
Private Utilities	X	
CenterPoint Energy	X	
AT&T	X	
Municipalities	X	
Missouri	X	
(Name of municipality)		
Other _____	☐	
Other _____	☐	

Sequencing Requirements (SR) and Other Considerations

SR:	
Permits:	
Other:	

Maintenance - Estimated Cost and Frequency (By the City)

Asset Categories	Estimated Asset Life	Maintenance Items	Cost	Schedule/Frequency
Streets	40-years	Street Sweeping	$ -	4 Times Annually
		Overlay	$ -	N/A
		Pot Hole Patch	$ -	As needed - typically starts year 25
		Panel Repair	$ -	As needed
Storm Drainage	50-years	Point Repair	$ -	
			$ -	
Water	50-years	Point Repair	$ -	
			$ -	
Wastewater	50-years	Point Repair	$ -	
			$ -	